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World Petroleum

SEVENTH
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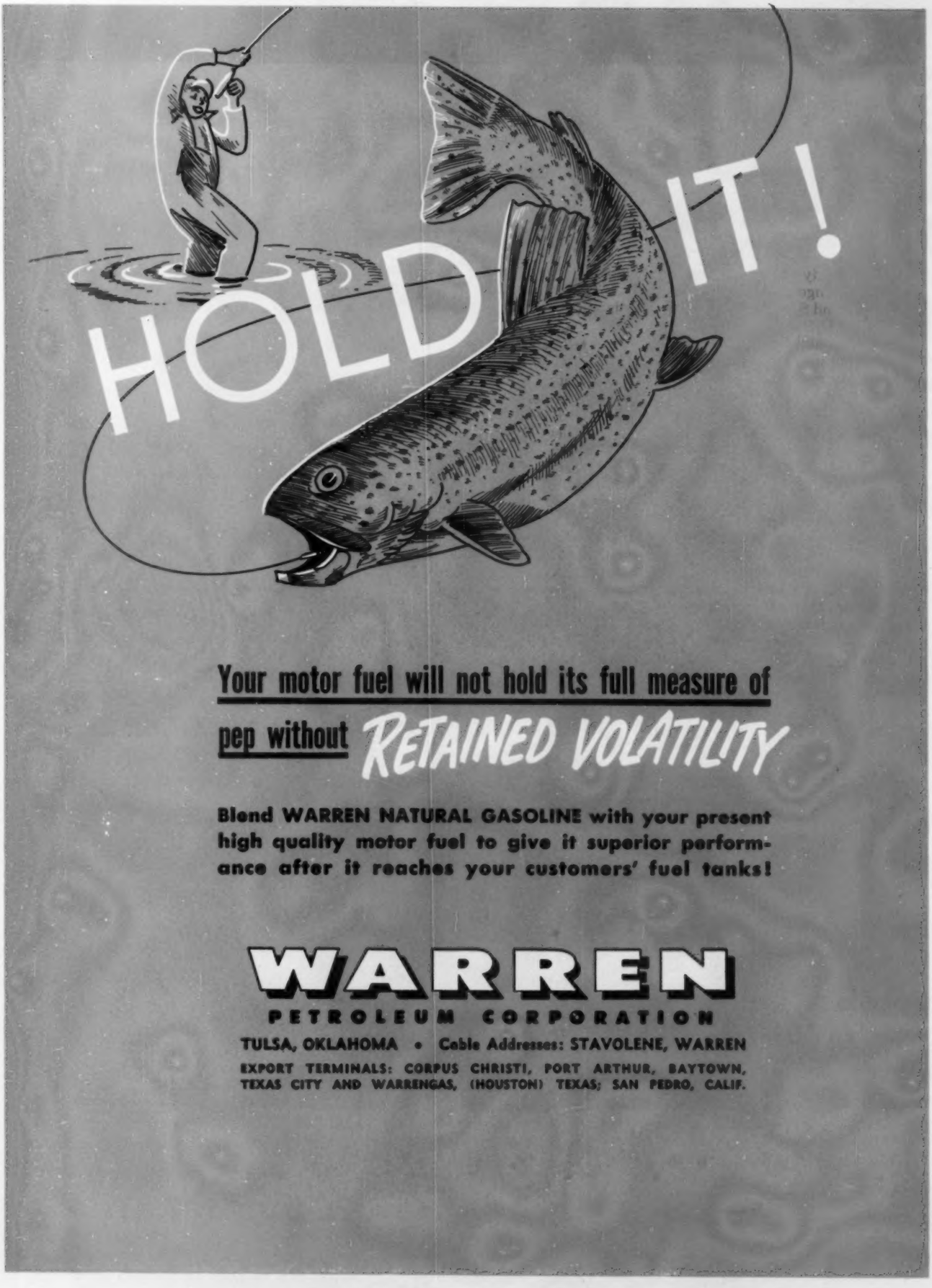

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How to get your top octanes more economically

By **HAROLD J. GIBSON**
Ethyl Corporation, Detroit, Mich.

With the growing trend to better-grade gasolines, the cost of producing those last few octane numbers has steadily increased. As a result, refiners are looking anxiously for more economical ways to get their top octanes.

Already octane numbers in the 97 to 98 range are being marketed in the East and Southwest. And the trends for all U. S. refineries in terms of pool, regular and premium fuels show that octane numbers are continuing a slow, steady rise each year.

To meet the demand for higher-octane fuels, refiners are being constantly forced to change their processes. In fact, trends indicate that by 1965 catalytic reforming may account for 50% of the total gasoline production in the industry.

Depending on the specific octane-improvement problem, the economic answer usually consists of a combination of tetraethyllead and various processing steps. The question becomes: How to determine the most economical way to get those top octanes? Only by conducting a detailed economic analysis can a refiner be sure of finding the best solution for his refinery, for from an economic analysis he can determine the proper balance between lead and a processing alternative.

An economic analysis will take into consideration all of the factors that affect the costs of making your gasoline: for example, optimum rates and yields, raw-material costs, product prices, operating manpower, maintenance and repair, utilities, depreciation, investment charges and reasonable "pay out."

Octane improvement analyzed

From such an analysis you can determine the economics of octane improvement, which is the tool for obtaining the optimum sequence of processing steps and attendant use of tetraethyllead. Analyzing octane improvement costs calls for a thorough understanding of unit operating costs, particularly when incremental expenses are being considered.

There are several approaches for analyzing the costs of octane improvement at higher levels. At Ethyl we have found, through our studies of the economics of top octanes, that the key to cost analysis is a value called *incremental cost*. Simply expressed, this is the rate at which costs increase as you raise the octane number. It can be expressed conveniently in cents per Research octane number per barrel. (¢/RONB).

Once you determine incremental costs, the next step is to make sure you are employing the best possible process at each point. By plotting the cost curves on a chart, you will see that up to a point the cheapest way to improve gasoline is with lead. Then lead becomes closely competitive with mild reforming methods.

After you reach an incremental cost of about 5¢/RONB, it again is definitely cheaper to add tetraethyllead. And finally when the full 3 cc. of lead is used, you must return to reforming—this time at greater severity.

Today there's a greater trend toward using lead in higher concentrations for, as one industry spokesman put it, "tetraethyllead has decreased steadily in price while the costs of refinery construction have continued to rise rather sharply."

FREE BOOKLET! Write for your copy of a recent 50-page report which gives important information on new processing alternatives and on the economics of top octane. Address your request to Department No. 16, Ethyl Corporation, 100 Park Avenue, New York, N. Y.

Lead addition now costs an average of 4 to 5 cents per Research octane number per barrel, and this is directly competitive with the cost of mild reforming operations for octane improvement. As product octane levels increase, refiners may have the choice of using maximum tetraethyllead—3 ml/gal—or going to more severe single-pass reforming or extraction followed by raffinate reforming. Here—even though lead susceptibility decreases somewhat in aromatic reformates—the cost of octane improvement by lead becomes increasingly more attractive as compared with various processing alternatives.

Where extremely high octane levels are required, a refiner has little choice but to use the more economic tetraethyllead to the maximum and then to vary his processing alternatives to give the desired product quality, if he wants to hold his manufacturing costs to a minimum.

What Ethyl Research offers you

Our Refinery Technology staff, backed up by the extensive facilities of the Ethyl Laboratories, will be glad to share their experience with your economics people when you conduct a cost analysis of your top octanes.

We will work with you, or if you prefer, we are even equipped to do a complete cost analysis for you.

We can help you answer these and other questions: When should you use "Ethyl" antiknock compound in preference to increasing the catalytic reformer charge rate? How does increased severity of reforming affect your costs? When should you carry your tetraethyllead content to the maximum allowable—and under what circumstances?

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3½″ O.D. M-3 Guns are used, firing a uniform pattern of four holes per foot, and resulting in fine producers.

McCullough M-3 Bullet Perforators are called upon again and again to do the toughest jobs. Solid steel gun bodies that give great strength and permit the use of the most powerful perforating powder loads, simultaneous firing that provides a uniform hole pattern and utilizes the full power of the gun on every shot, and improved Ogival Bullets are a few of the reasons why you get deepest penetration.

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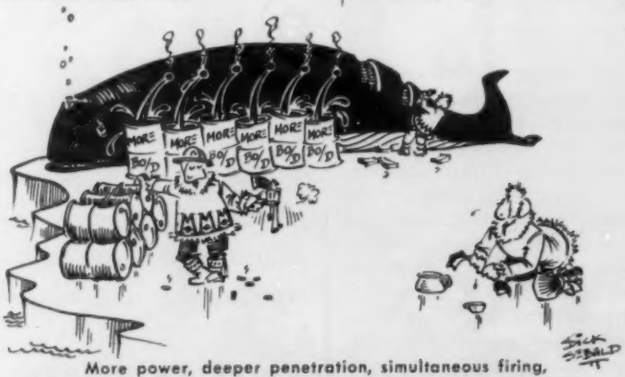
9738 improved ½″ Ogival Burrless Bullets were fired in several pay zones. Total depth was 9510 feet and 7″ O.D. 26 lb. and 29 lb. N-80 casing had been cemented through the productive intervals. Guns used were the 4¼″ O.D. M-3 Bullet Perforators . . . the world's best!

The well started flowing after perforating began and made 1700 barrels of oil during the job. A blowout preventer had to be used to keep the well under control, indicating the extent of the problems overcome to accomplish this all-time record.

Records like this can only be established by M-3 Bullet Guns; the original solid steel bodied bullet guns that fire all shots at one time and gain deeper penetration than any other bullet gun. These guns save valuable rig time on any perforating job. On jobs over 100 holes the saving is substantial. On this record breaker the operator realized a tremendous saving; McCullough crews fired an average of 83 burrless bullets per hour.

All 9738 bullets shot in this well were improved ogival McCullough Burrless Bullets. The entire perforated zone was scraped on a single run. The scraper came out without a scratch—no damage from burrs or bullets; and the zone washed perfectly!

This entire operation was as smooth as silk—a fine tribute to the skill and efficiency of McCullough gun crews and to the excellent completion program established by the oil company's engineers.



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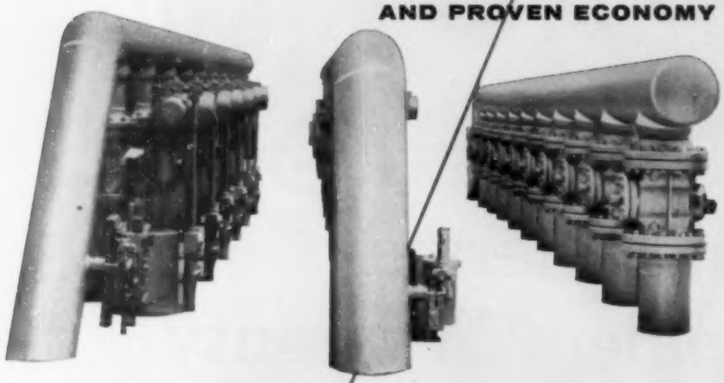

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By Joseph B. Huttlinger

Half a dozen of the largest natural gas companies in the world are working out plans to move gas from western Canada to the United States and eastern Canada.

As they press their plans, within the industry, and before governments both of Canada and the United States, they face a battle over who gets the franchise to move the gas to markets.

As it stands, the leader is a project proposed by the Tennessee Gas Transmission Co., and its new subsidiary, Midwestern Gas Transmission Co. At that, the project is given no better than a 50-50 chance by those close to the case.

Under this plan, Midwestern would import 200 million cubic feet of gas a day from Canada along the Minnesota border, and serve the vast Midwest market through a new $98 million pipe line. Midwestern would take an equal amount from Tennessee at Portland, Tennessee, and bring it north to further feed the market.

To supply Midwestern, Trans-Canada Pipe Lines, Ltd., would bring its vast line across Canada.

Tennessee, meanwhile, would feed more gas into Montreal (about 87 million cubic feet daily) and other eastern Canada cities until the Trans-Canada line was completed across to the east. Then, Tennessee would be in a position to begin importing Canadian gas.

As for Trans-Canada, it would lay its line at the western and eastern ends, and the Canadian government would lay a long segment of it spanning the Great Lakes, which is regarded as not economically feasible. The total would be 2,200 miles.

The huge United States companies opposing the Tennessee-Midwestern project, agree completely on the need for Canadian gas in the United States. But they want to bring it in, and they say they have better plans, plans which are financially sound.

Northern Natural Gas Co., which has asked the Canadian authorities for permission to bring in a pipe line full of gas to the United States, says through its counsel, Justin Wolf: "Fifty percent of the gas supply behind these projects, that is the gas to come from Canada through the medium of Trans-Canada Pipe Lines, Ltd., rightfully belongs to Northern. We are here to oppose this matter as long as it takes to oppose it."

Natural Gas Pipe Line Co. of America, and Texas Illinois Natural Gas Pipe Line Co., which claim this area as its market, are opposed.

Natural Gas is proposing its own plan to head off Tennessee: A new line to bring to the United States midwest 350 million cubic feet of gas daily from the Rocky Mountain area, which in turn would call for a supply from and expansion by Colorado Interstate Gas Co.

As for American Louisiana Pipe Line Co., and Michigan-

PIPE LINE

Wisconsin Pipe Line Co., Charles F. Shannon, counsel, says, "American Louisiana has half completed a line from the Louisiana Gulf Coast to Wisconsin to carry 300 million cubic feet daily and Michigan-Wisconsin is taking the gas and has agreements with seven distributing companies. Michigan-Wisconsin wants to hold these markets.

"We desire to be heard on every phase of this project, and we are prepared to spend the two to three years that will be required for hearings on this proposal if Midwestern's application is not summarily dismissed by the commission as will be requested to be done."

One person who is happy about the whole scrap is Thomas J. McGrath, counsel for coal and railroad interests, who devotes much of his life to fighting any and all natural gas projects.

"My pleasure," he says, "derives from the fact that apparently they are going to be at each other's throats, more or less. To be relieved of the necessity of carrying the entire burden of opposition against the institution of natural gas pipe line service is a relief from a very substantial burden. I hope to sit back and enjoy seeing these fellows go after each other, hammer and tongs, as they threaten to do."

New McMahon Plan—For instance, a completely new idea has been advanced by Frank McMahon, for building the cross-Canada line without government financial help other than relief from sales taxes and import duty.

This plan also calls for a new deal, under which the Canadian gas would be sold to companies backing the plan, such as Northern Natural, Michigan Consolidated Gas, and American Gas Co.

Frank McMahon is the originator of the large Westcoast Transmission line, for which he got FPC approval of imports of Canadian gas in the Peace River area of northwestern Canada into the United States northwest through an arrangement similar to that which he is proposing now.

His plan calls for about 70% of the financing through the United States investment concern of Eastman, Dillon and Co. A large part of the stock would be held by McMahon interests. The deal would call for both Canadian government and FPC approval as do plans presently under consideration. There is one important difference, however. Mr. McMahon is reportedly willing to build the section from western to eastern Canada right away, with no government financing and without waiting for FPC approval.

The Tennessee-Midwestern plan, however, is before FPC for a hearing. Canadian authorities have given tentative approval, providing the project gets started by November 1. At first, May 1st was the deadline, but this has been extended.

Chances are that the November 1 deadline will come with the case still in the hands of the FPC. The time table of the case ahead looks like this: Midwestern and Tennessee applications in the case were filed in November, 1955.

Hearings before Examiner Francis Hall of the FPC opened February 14. The direct case is taking until the end of April to put on.

(Continued on page 142)

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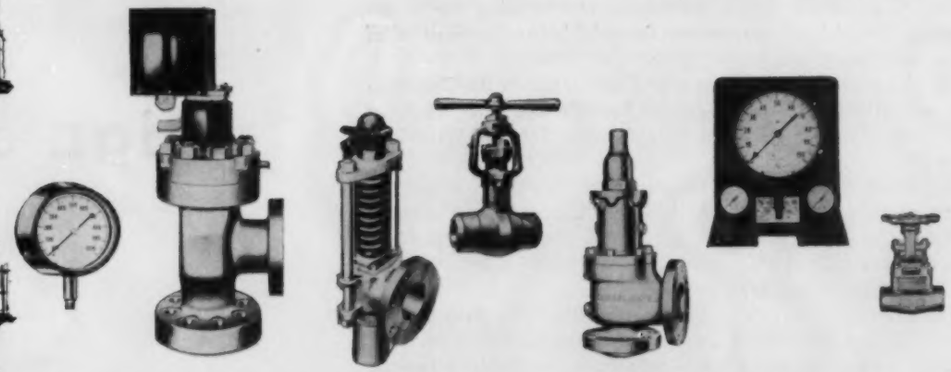

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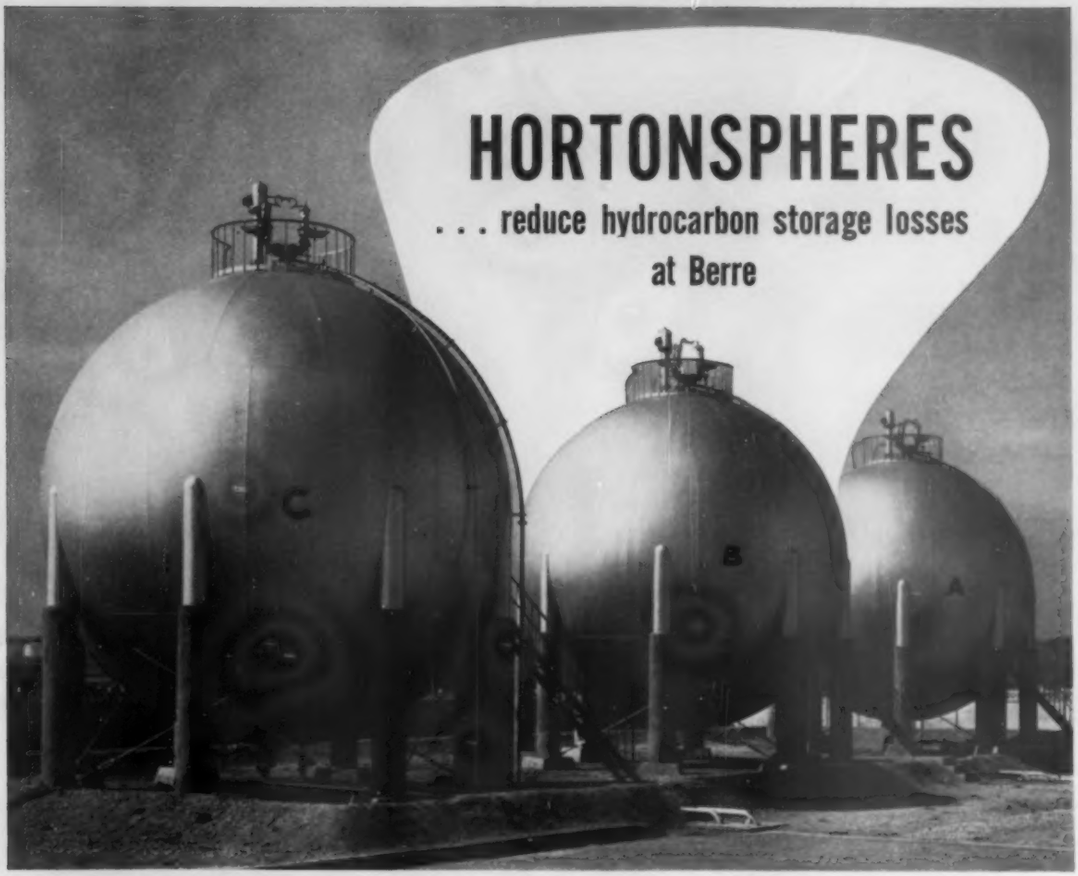

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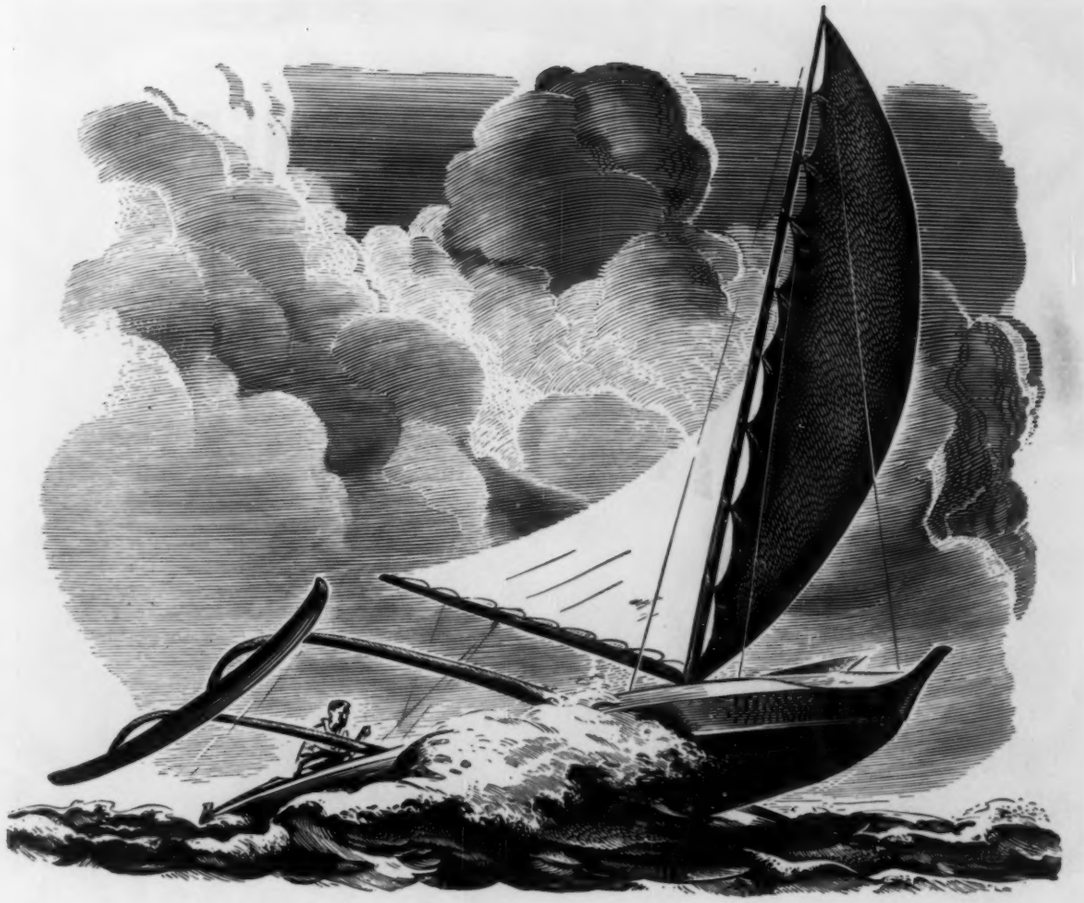

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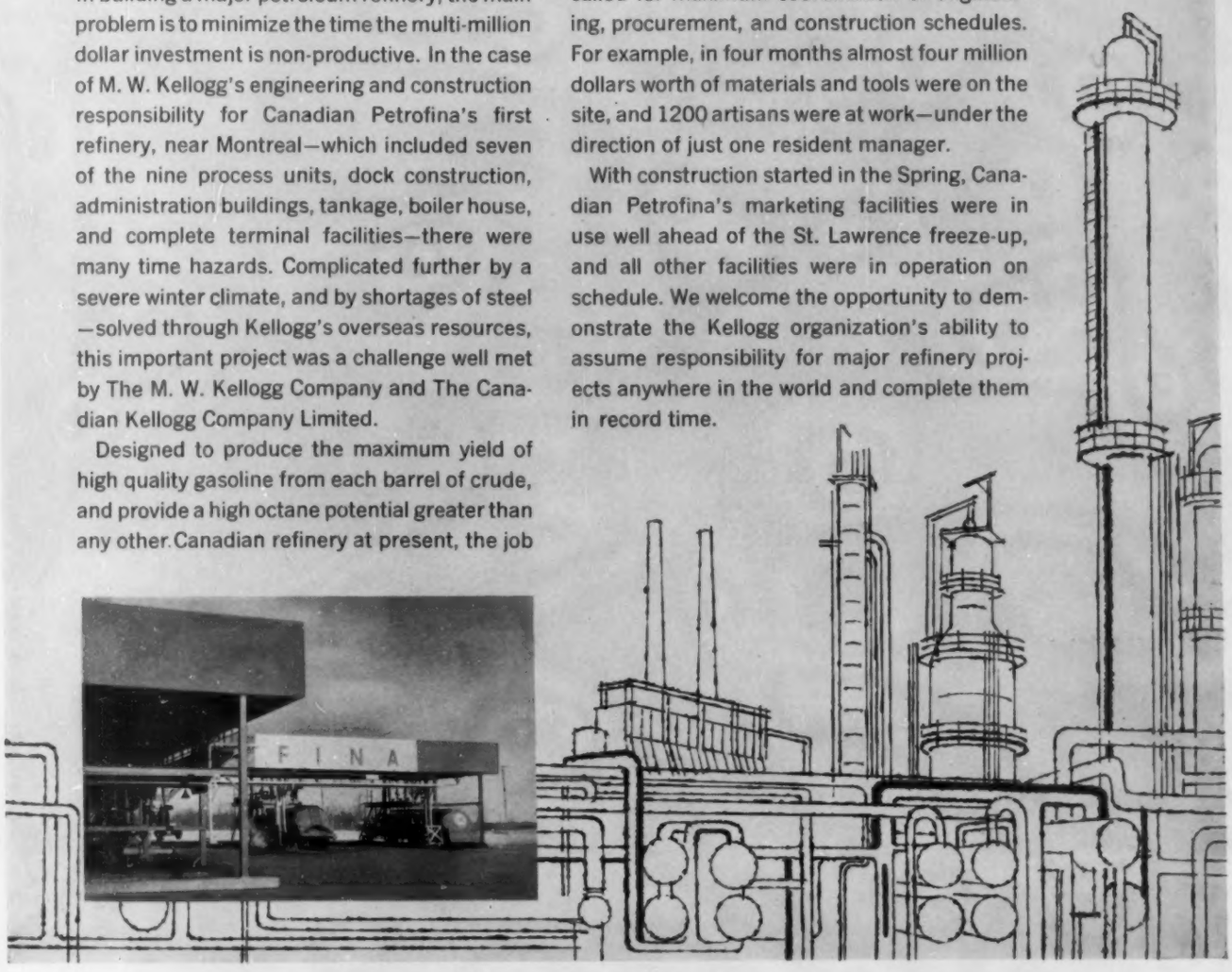

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WHEN Radio Materials Corporation of Chicago, manufacturers of electronic components, added a new plant 135 miles away in Attica, Ind., it solved an expansion problem but ran into a transportation problem.

Executives shuttling between the two facilities were losing valuable working hours enroute. Road travel meant a three or four hour trip and even when using the company's fixed wing airplane, the two hours by auto between plants and airports couldn't be overcome.

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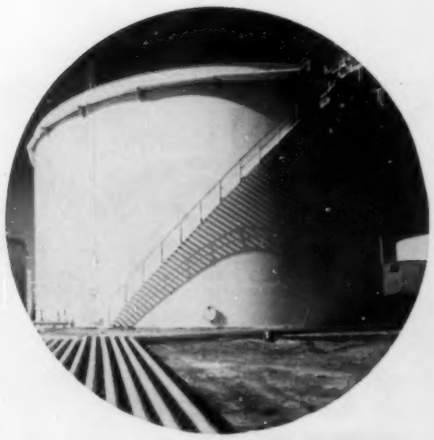

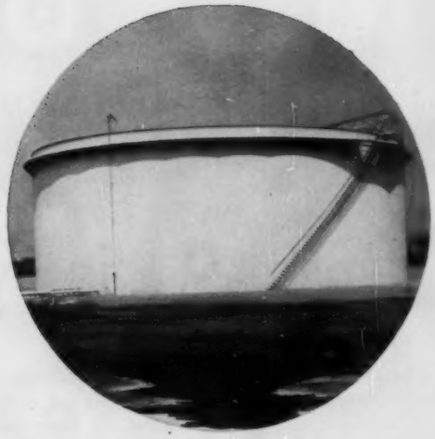

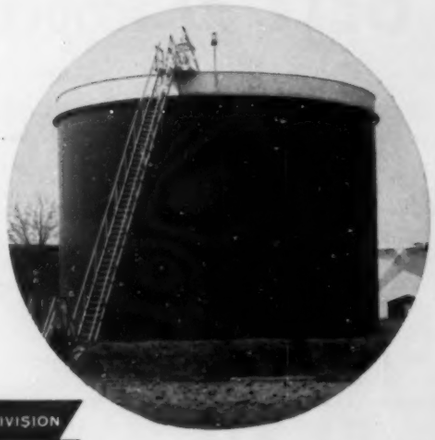

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NEW RUGGED CONSTRUCTION! All new International models are equipped with long-life power-grip cerametallic clutch facings, improved positive track-roller seals, reserve track-frame strength and live-action traction weight.

New TD-18 and TD-14 have heavy-duty "swinging door" radiator guard for mounting direct-lift equipment. New vertical louvered grill on TD-9 and TD-6.

See your IH dealer for a powerful demonstration or write for catalog. Complete line of new IH matched hydraulic or cable graders and dozers available for every new International crawler model.

TD-6 41.5 drawbar hp. 8,890 lbs.

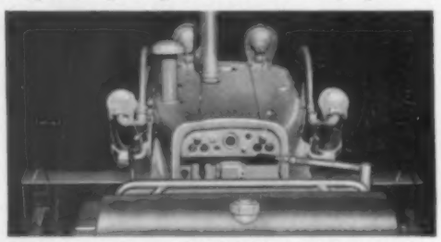
TD-9 54.5 drawbar hp. 12,000 lbs.

TD-14 78.5 drawbar hp. 21,095 lbs.

TD-18 103 drawbar hp. 29,050 lbs.

TD-24 161 drawbar hp. 42,780 lbs.
200 engine hp. (torque conv.) 43,080 lbs.

Operating weights shown less equipment.



NEW "CONTROL-TOWER" VISIBILITY! All models have full job-control view, one-glance instrument panel, wide foam rubber seat, big arm rests and flush air-cooled deck. Exclusive IH Planet-Power steering on TD-24, hydraulic steering on the 18 and 14, spring booster steering on the 9 and 6. Driver does more work, easier, faster.

INTERNATIONAL HARVESTER

INTERNATIONAL INDUSTRIAL POWER

INTERNATIONAL HARVESTER EXPORT COMPANY, 180 N. MICHIGAN AVE., CHICAGO 1, ILL., U.S.A.

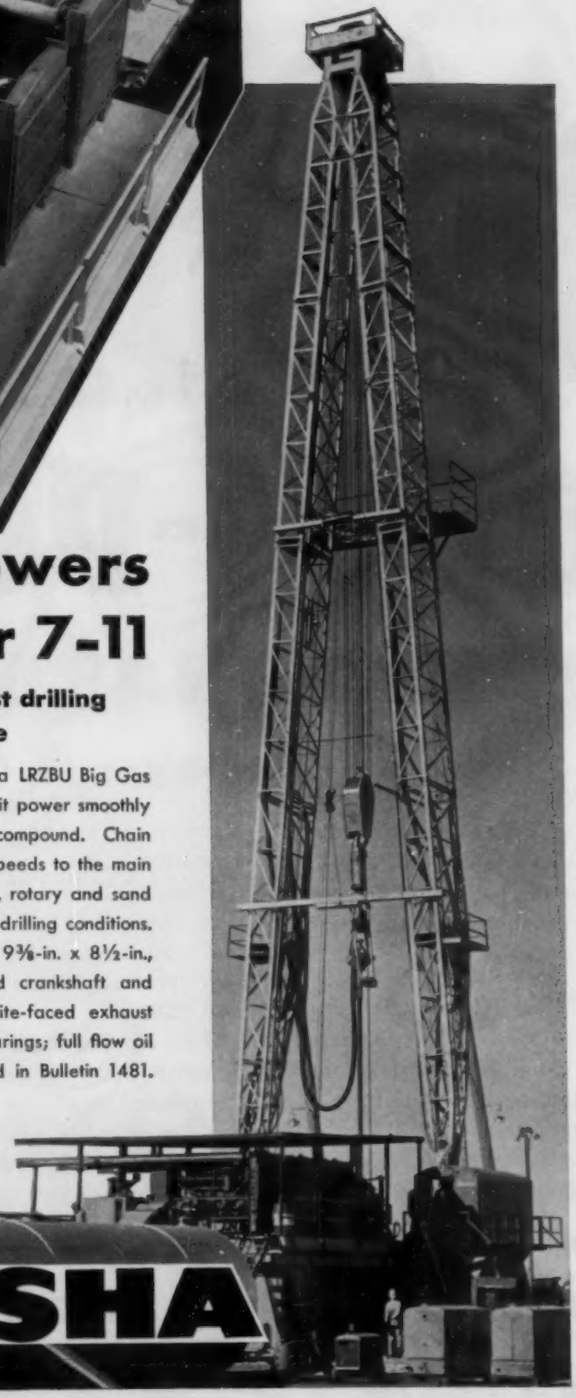
On location for Durham Drilling Co., West Texas—this Super 7-11 rig has three LRZBU Waukesha Gas Power Units.

WAUKESHA powers this IDECO Super 7-11

1250 hp input (nominal) — for low-cost drilling to 12000-ft. with 4½-in. pipe

SUPER POWER for this Super 7-11 rig! Three Waukesha LRZBU Big Gas Units, each capable of 550 max. hp at 1200 rpm—transmit power smoothly through disconnecting fluid couplings to the sectionalized compound. Chain and gear transmission, with six forward and two reverse speeds to the main drum and three forward and one reverse to the catheads, rotary and sand line drum, give a range of speed and torque to meet all drilling conditions. Completely air controlled. The Waukesha LRZBU—6-cyl., 9⅜-in. x 8½-in., 3520 cu. in.—has a 7-bearing 5½-in. counterbalanced crankshaft and aluminum pistons; renewable, wet cylinder sleeves; Stellite-faced exhaust valves with Stellite seats; full pressure oiling; precision bearings; full flow oil cooler; many other modern design features; all described in Bulletin 1481.

WAUKESHA MOTOR COMPANY
WAUKESHA, WISCONSIN
New York • Tulsa • Los Angeles



WAUKESHA

285

Throughout the petroleum industry . . .

FLUOR BUILDS PROCESSES INTO PROFITS

Research is the key to tomorrow's profits. And no group is more research-minded than America's refiners, whose future growth depends largely on new methods and processes.

But before research ideas become salable products, bench-scale operations must be translated into operating plants. Throughout petroleum refining . . . as in petrochemicals, chemicals, fertilizers, electric power, and atomic energy . . . it's a growing habit to call Fluor to bridge this gap, for industry has found during the last 40 years that for efficiency, dependability, long life, you *can* be sure with Fluor.

FLUOR of CANADA

THE FLUOR CORPORATION OF CANADA, LTD.

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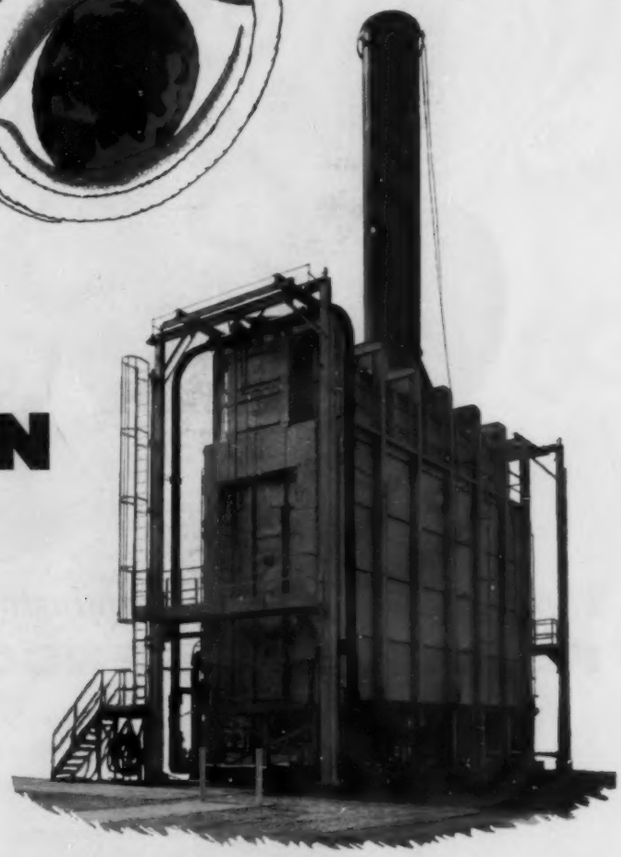
Petroleum Institute
Refinery Division
Spring Meeting
Montreal, May 14-17

Manufacturers Life Building, 200 Bloor Street East, Toronto • Affiliated with H. G. Acres & Co., Ltd., Niagara Falls, Ontario

Need a Heater?

BUY IT WITH...

BOTH EYES OPEN



There are darn few supply stores in the jungles of Brazil or the rugged hills of Portugal. And that's one of the reasons why plant executives with an eye on foreign operations choose BORN "UPFLO" HEATERS. Repairs, maintenance, or shut-downs in these remote areas are costly, so a heater which can deliver year after year of trouble-free operation will result in tremendous savings.

But there's *another* side to the story of Born's popularity, too. In North America, Born heaters are saving millions of dollars every year, even though they may be right next door to a supply house! That's because BORN "UPFLO" HEATERS are *more efficient;* save on fuel costs every day they're in operation.

At this moment, BORN "UPFLO" HEATERS have been furnished for service in India, the Philippines, Formosa, Brazil, Venezuela, Colombia, Italy, Japan, and Portugal — in addition to the hundreds of Born heaters all over the United States and Canada. Over 1,000,000 barrels of Petroleum Oils and Distillates *per day* are being economically processed by these efficient, rugged units.

Just where the next "UPFLO" heater will crop up, nobody knows. But you can bet your best "Stetson", it will be ordered by an executive who does his buying with *both eyes open!*

BORN *Engineering Company*

ENGINEERS and CONTRACTORS

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PETROLEUM CHEMICALS DIVISION
NEWS

May ★ One of a Series of Bulletins for the Petroleum Industry ★ 1956

ONE COMPLETE LINE

Only Du Pont offers you a *complete* line of additives . . . for gasoline, for diesel and heating fuels, and for lubricating oils. Du Pont also offers grease stabilizers and dyes. To bring yourself up to date on the benefits of these products, read about them below and on the next page.

1. AN ASHLESS heating and diesel fuel oil additive. (See below.)
2. A NEW TYPE of lube oil additive that fills the growing need for low-duty detergency. (See below at right.)
3. COPPER CONTAMINATION in a wide variety of petroleum products can be controlled. (See article on Du Pont Metal Deactivator on next page.)
4. COLOR is adding new sales advantages to many petroleum products. (See next page.)
5. GREATER ECONOMY can result from purchasing Du Pont additives in carload lots. (Read about it on the next page.)
6. MULTI-PURPOSE greases for high temperature service require additional stability. (The Du Pont grease stabilizers written up on the next page can help you achieve it.)

ASHLESS additive to help you avoid oil burner and diesel troubles

Since it is a nonmetallic ashless additive, Du Pont Fuel Oil Additive No. 2 (FOA-2) does not leave a metallic ash deposit that can foul the operation of oil burner electrodes and stack controls. Also, it can be used in diesel fuels without any danger of contributing to exhaust sparking.

Many other advantages

Added to freshly prepared heating oil stocks at the refinery, FOA-2 retards the formation of insoluble residues in storage and customer tanks. It also reduces the particle size of any residues that are formed and helps to clean out any sludge deposits that might previously have formed in oil burner systems.

In diesel fuels, its stabilizing and dispersant action can help prevent injector sticking and filter plugging. In this way, FOA-2 provides a means of making economy grade, cat-cracked fuels highly acceptable for diesel operation.

New setup to expand customer service to refiners on Du Pont additives

The continuing upsurge in both volume and quality of petroleum products has increased the demand for all types of chemical additives. To meet this growing demand, the Du Pont Petroleum Chemicals Division has recently followed the lead established for TEL and streamlined its sales and technical service setup for the handling of all Du Pont additives.

J. J. MIKITA, right, Sales Manager, additives, and RICHARD O. BENDER, an Assistant Director of the Petroleum Laboratory, head up the new Petroleum Chemicals Division additives sales and technical service groups respectively.

To meet your need for low-duty lube oil detergents

Du Pont Lube Oil Additives 564 and 565 were especially developed to give effective detergency to motor oils for low-duty, around-town driving conditions. In addition to their detergency action, they will also add a substantial amount of your desired viscosity-index improvement.

Since a large part of the average motorist's driving is in stop-and-go city traffic, these unique additives offer you a strong promotional appeal for your motor oils.

•

A group under Mr. J. J. Mikita will have charge of the sale of Du Pont Metal Deactivator, gasoline antioxidants and dyes, fuel oil and lube oil additives, and grease stabilizers. In his former capacity as director of the Du Pont Petroleum Laboratory, Mr. Mikita had unusually broad experience in the development and application of all types of petroleum additives.

Mr. R. O. Bender, who has also been closely associated with the development of many Du Pont additives, will now be headquartered at the Du Pont Petroleum Laboratory. There, as an assistant director of the Laboratory,

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *New Service Setup*

he will be able to closely coordinate the Laboratory's work with technical service for customers.

The new setup will provide thoroughly experienced personnel ready at all times to help refiners on both technical and commercial problems concerning the use of additives.

Together, these groups will devote their entire energies toward helping refiners make the most efficient use of Du Pont's complete line of additives for gasoline, diesel fuel, heating oil, lube oil, grease and other products.

Du Pont Metal Deactivator has wide range of valuable applications

In addition to gasolines, the list of products that can be improved with Du Pont Metal Deactivator (DMD) includes diesel fuels, home heating oils, kerosines, jet fuels, turbine oils, and greases.

Wherever copper contact is a possibility, there is danger of contamination and gum formation. But in most cases, a very small amount of DMD will supply adequate protection against the harmful effects of copper.

To help you take advantage of the benefits of Metal Deactivator in many different products, Du Pont offers comprehensive technical services. And these services are geared to your own individual needs and manufacturing operations.

Convenient laboratory help

The facilities and experience of the five Du Pont regional laboratories are an important part of these services. The laboratories may be able to help you put your whole additives program on a more economical basis.

For example—because combinations of DMD and other Du Pont additives often work more efficiently than one additive alone, the Du Pont laboratory recommendations can help you achieve your desired stability with less additive . . . often at a substantially lower treating cost.

Color helps you sell, identify, add interest to MANY petroleum products

Color is becoming a bigger factor in our everyday lives . . . and in the competitive struggle for sales. You see it in the cars on the street, in home decorating, in sport shirts at the beach.

It's important in petroleum products, too. Leaded gasolines have always been dyed. And many refiners have used gasoline dyes to match their pumps, station trim and brand identification signs. Many use it for sales promotion purposes in their motor oils, also.

TO GET the best results with Du Pont additives, you are always welcome to use the services of our conveniently-located regional laboratories.

Now greases and fuel oils are becoming more colorful. And the advantages of this go beyond the promotional value. Colored greases help service station personnel and industrial lubrication engineers identify the products and check their work. Fuel oils and other products can be readily identified by grade during pipeline shipments and at other points by the simple addition of color.

For adding these advantages to *all* your products, Du Pont offers a complete line of oil-soluble dyes—yellow, orange, red, blue and bronze. Their color stability is outstanding. And they are highly concentrated for economical use.

Grease stabilizers to meet varying requirements

As operating speeds and temperatures are pushed higher, grease stability is of increasing importance.

Du Pont "Ortholeum" 300 is highly effective as a metal deactivator, as well as an antioxidant. This quality is especially important in heavy-duty industrial greases which come in contact with bearings containing brass. It also provides unusually good resistance to color deterioration.

Du Pont phenyl-alpha-naphthylamine gives excellent results in most non-catalyzed systems. Where operating conditions are not too severe and competitive pricing is important, it can be used to increase stability at relatively low cost.

To help you save on cost of additives . . .

Du Pont additives are available in carload lots.

With Du Pont Antioxidant No. 22, for example, you can save about 6% by purchasing it in tank car lots. Such a saving can mean an important profit advantage to you. And we will be glad to ship these carload lots in special tank cars, equipped with steam coils to facilitate easy unloading.

DU PONT

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A-1736

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The period of "on stream" operation of refinery equipment is the period of *profitable* operation. To keep time down to the bare minimum during turn-arounds, General Refractories maintains stocks strategically located in plants and Company and dealer warehouses throughout the world that can be called upon for fast delivery.

And General Refractories Company—with a complete range of products including castables, plastics, ramming mixes, fire brick, mortars, insulating brick and insulation —is anxious to have one of its qualified representatives on hand for consultation when your refractory repair or new construction begins.

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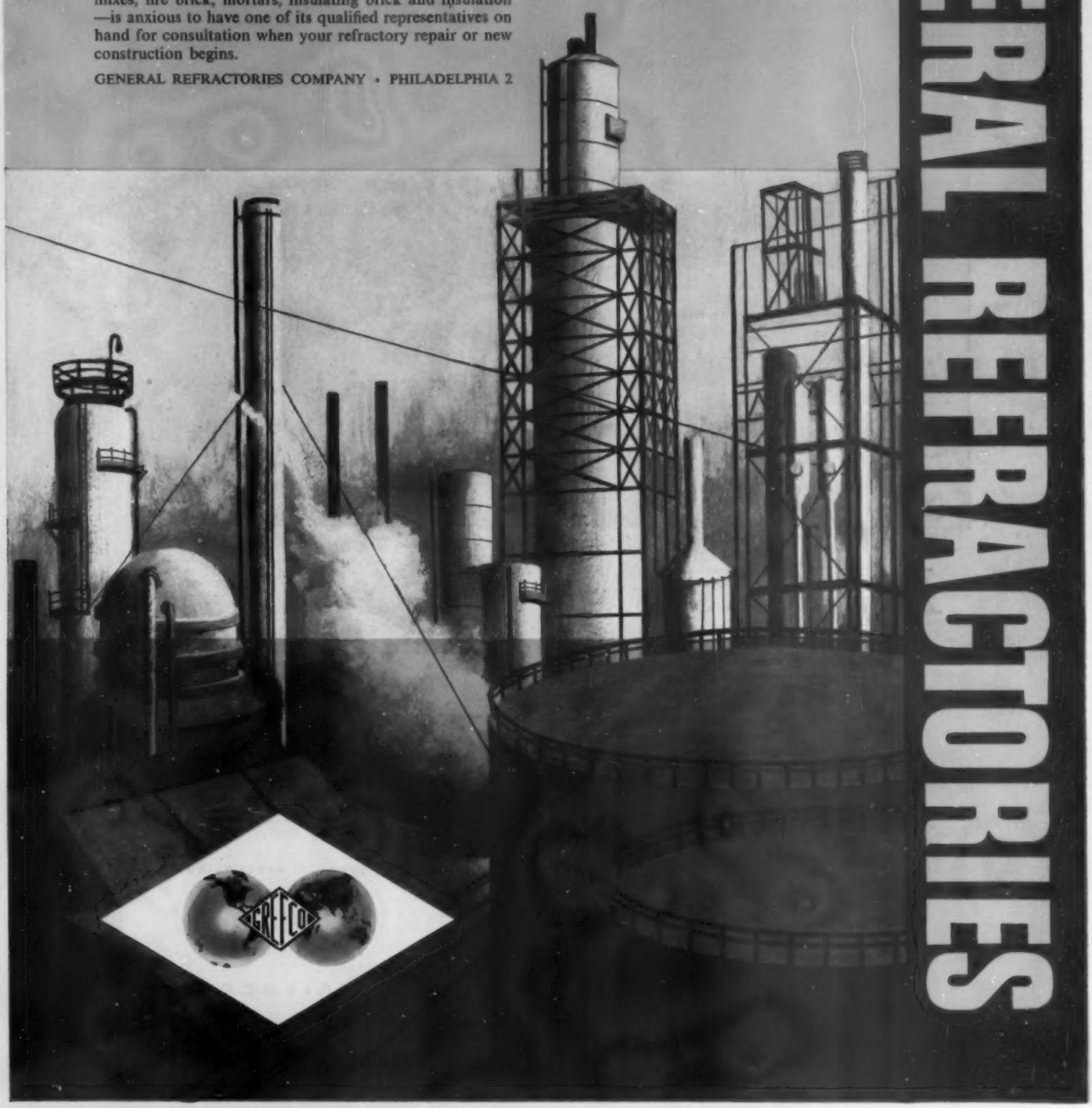

Getting the most from data obtained is a matter of skill and experience. The key personnel in IX interpretation average more than 15 years experience.

Experience

is the key to skilled seismic interpretations at IX

The personnel of Independent Exploration Company has packed more than 1,559 man years of experience into the company's quarter century of service to the oil industry. The men who supervise your seismic surveys grew up with the industry. That's why Independent Exploration Company can offer you the tops in fast, accurate, informative geophysical surveys. Next time, call in IX for a better job.

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OVER 1,559 MAN YEARS OF EXPERIENCE

"At a time when drilling costs are high and footage bids are low..."

Hi-Tower Drilling Co. uses Reed Super Shrink-Grip Tool Joints exclusively...

Norman Vetters,
Drilling Superintendent,
Hi-Tower Drilling Co., Ltd.

HI-TOWER DRILLING CO., LTD.
400, LANCASTER BUILDING — CALGARY, ALBERTA

June 16, 1955.

Mr. H. E. Wilson,
Manager,
Reed Roller Bit Co. of Canada Ltd.,
Lancaster Building,
Calgary, Alberta.

Dear Mr. Wilson:

To supplement our conversation of this morning, I thought you might like to have the following information on the string of Reed Super Shrink-Grip Tool Joints used on our Rig No. 5 now moving into Saskatchewan:

Type of Tool Joint:	Reed 4½" Full Hole
Purchased:	July, 1951.
Footage Drilled as of June 16, 1955:	142,559'
Number of Wells Drilled:	52.
Locations:	Virden and Legal areas.

The performance of this string of joints is typical of the extra long service life we have received from all of the Super Shrink-Grip Tool Joints we have used and are presently using.

At a time when drilling costs are high and footage bids are low, we are especially pleased to have dependable Reed Tool Joints exclusively on each of our eight rigs.

Yours very truly,

HI-TOWER DRILLING CO. LTD.

JWW/jb Per: J. W. Wark
J. W. Wark,
President.

142,559 feet drilled and still giving dependable service...

The proof is in drilling performance — From both a cost and service standpoint Reed Tool Joints prove best.

That's why Hi-Tower Drilling Co., Ltd., of Canada has standardized their eight strings of drill pipe with Reed Super Shrink-Grip Tool Joints.

Cut drilling costs by using Reed Tool Joints exclusively on your rigs.

REED
ROLLER BIT COMPANY
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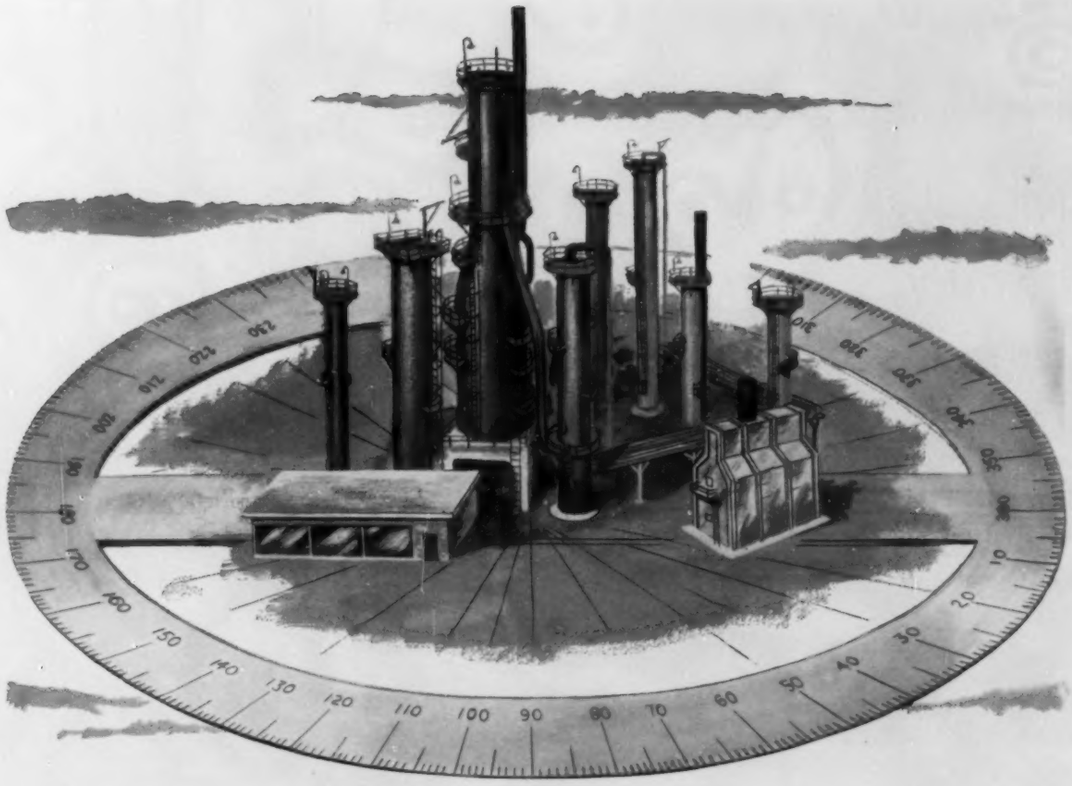
Gulf Coast, Mid-Continent, Rocky Mountain and Canadian Distributor for Martin-Decker Products



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No matter how you look at it, PROCON'S dependable and complete process construction service includes every high standard of efficiency, economy, and quality. Oil refining, chemical, petrochemical companies look with confidence to PROCON for planning, engineering, procurement, construction, and inspection . . . all under ONE responsibility.

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Stability,

. . . a basic ingredient in Davison's Petroleum Catalysts

Davison achieves it through control of filament size and orientation (see illustration below). Davison catalysts possess greater mechanical strength because of their larger filament diameters. The orientation of these filaments provides a catalyst of large pore diameters.

These two factors combine to give Davison catalysts longer life through greater stability.

Davison has for many years been the leader in the production of catalysts. This leadership has been maintained through Davison's continuing ability to produce catalysts designed to meet the requirements of all types of fluid catalytic cracking units.

For information on Davison catalysts, see your Davison Representative, or write

DAVISON CHEMICAL COMPANY
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Structural Stability, Catalyst in the form of submicroscopic filaments provides the surface area on which catalytic reactions take place. Large filaments give greater mechanical strength.

Thermal Stability, The graph compares high pore diameter catalysts (in blue) with ordinary catalysts. By resisting heat deactivation, high pore diameter catalysts have a higher useful activity.

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horsepower ≠

Most Powerful Gas-Engine-Driven Compressor Ever Built*, Delivered by Clark in 4½ Months

Michigan Gas Storage needed a substantial block of compressor horsepower at their Freedom Station in Southern Michigan and they needed it in a hurry. The problem was to build up enough underground gas reserves to meet anticipated heavy winter demands.

They had plenty of station flexibility because of the 12 Clark BA compressors already operating. Therefore, one big unit seemed to be the least costly and the fastest to install. A Clark Turbo-supercharged Model TLA-10 would develop the horsepower required. The efficiency guaranteed by Clark would also mean considerable savings in operating costs.

At the time the need became evident, a Clark TLA-10 had never been built. Nevertheless, Clark promised to build, test and ship this 150 ton unit, including the special turbocharger, in 4½ months or less. The promise was kept and Michigan Gas Storage met their commitments.

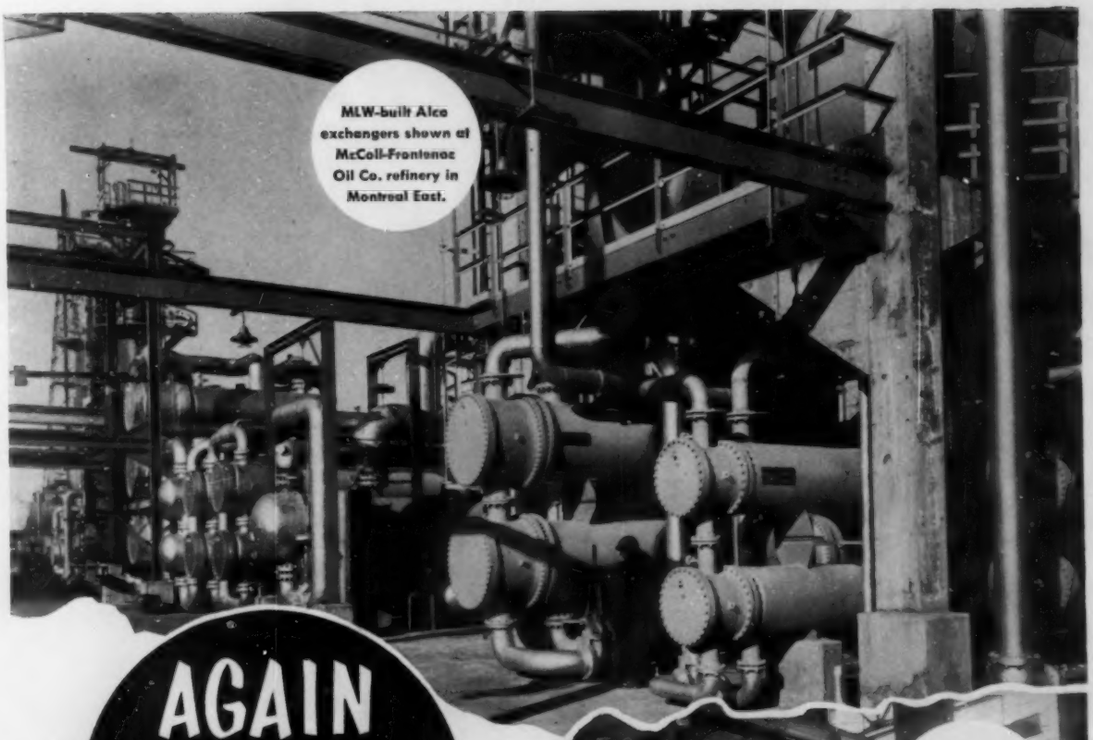
For your big jobs, where large amounts of horsepower are required, the big TLA models will really save money before and after installation. For the somewhat smaller installations or those requiring more flexibility, Clark has other Turbo-supercharged models that are equally efficient although less powerful. Eight sizes in the 1100–3400 BHP range are available. Your nearest Clark office will be pleased to furnish you with complete information, or write for bulletin No. 134.

**The TLA-10 operated by Michigan Gas Storage Company is rated at 3300 BHP. Latest models are rated at 3400 BHP.*

CLARK BROS. CO., OLEAN, N. Y.
One of the Dresser Industries
Offices in principal cities throughout the world.

CLARK®

Turbo-Supercharged Compressors



MLW-built Alco exchangers shown at McColl-Frontenac Oil Co. refinery in Montreal East.

AGAIN it's MLW

Exchanger tube bundles undergo hydrostatic tests at MLW plant.

Heat exchanger tube sheet is drilled with modern triple head radial drill.

When one make of equipment is regularly specified more than others, there must be good reasons. In the case of MLW-built Alco heat exchangers—most widely specified in the petroleum, petrochemical and chemical industries—the reasons are these:

- **Sound engineering and fabricating practices.**
- **Long proven record of efficiency and reliability.**
- **Meticulous attention to detail and specifications.**
- **Production techniques resulting in improved heat transfer equipment.**

MLW produces Alco heat exchangers in all conventional diameters and weights. Pressures range from high vacuum to 3000 psi, temperatures from minus 300° to 1150° F. Built to TEMA standards and ASME codes.

MLW

Thermal Products Division

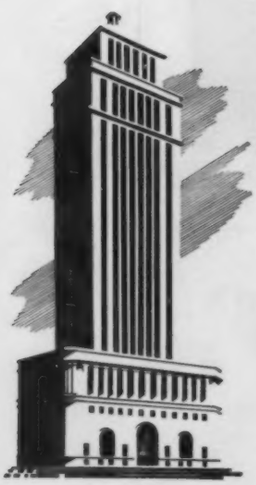
MONTREAL LOCOMOTIVE WORKS LIMITED

FIRST

in Canada's Oil Fields

The Royal Bank of Canada, Canada's largest bank, whose clients include many of the most prominent firms in the field, offers exceptional services to the petroleum industry. Its Oil and Gas Department, manned by experienced officers in close touch with the situation, provides information, guidance and practical aid to prospective entrants.

In Alberta, Canada's oil-rich province, Royal Bank branches number 63, including Calgary, Edmonton, Leduc, Devon, Redwater, Drayton Valley and Turner Valley. In Saskatchewan, Manitoba and British Columbia, branches total over 200. *We do not provide information on oil securities.*



The Royal Bank issues bulletins from time to time covering statistics, regulations, tariffs, oil and gas financing, and kindred subjects. These are free on request. For a list of current bulletins write to The Royal Bank of Canada, Oil and Gas Department, 409—8th Avenue West, Calgary, Alta.

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Over 850 branches in Canada and abroad

New York Agency — 68 William St., New York

Standard is exploring 40 countries* to keep America's oil reserves the highest in history

Specially designed "swamp buggy" carrying oil geologists into a Louisiana wilderness

SWAMP BUGGIES, snowmobiles — even helicopters — are used by Standard's geologists, who seek petroleum throughout the free world and in 33 U.S. states. Our search never ends. Last year, in the Western Hemisphere alone, Standard invested $134 million in exploration, drilled 107 test wells. We added nearly three times as much oil to reserves as we brought from the ground. But U.S. consumption rises steadily. It's now over 9 million barrels *per day* and expected to increase ⅓ within 10 years. So in 1956 we'll again invest many millions in exploration, drill scores of new wells—seeking the oil you'll use tomorrow.

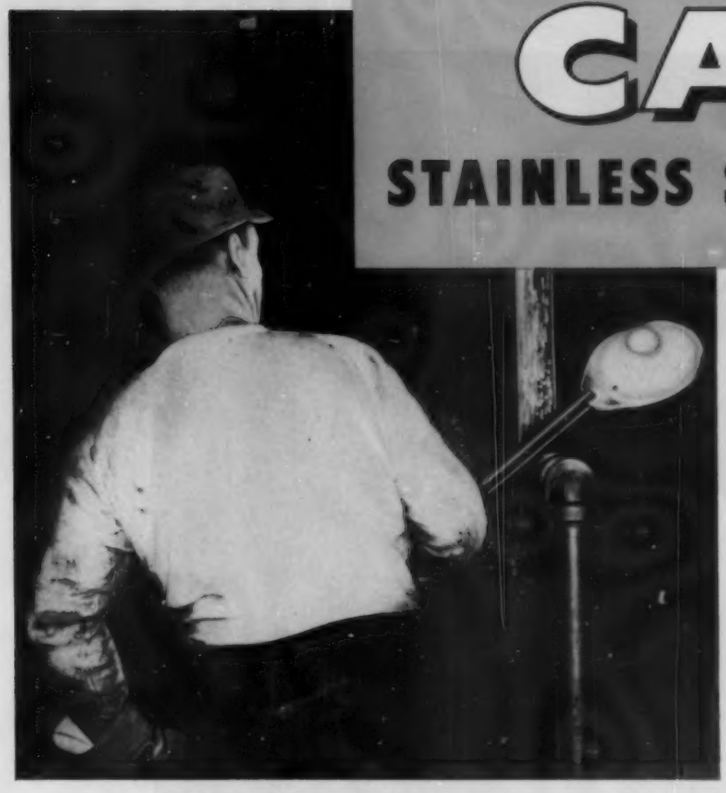
* *Includes operations of affiliated companies in the Eastern Hemisphere*

STANDARD OIL COMPANY OF CALIFORNIA
puts petroleum progress to work for you

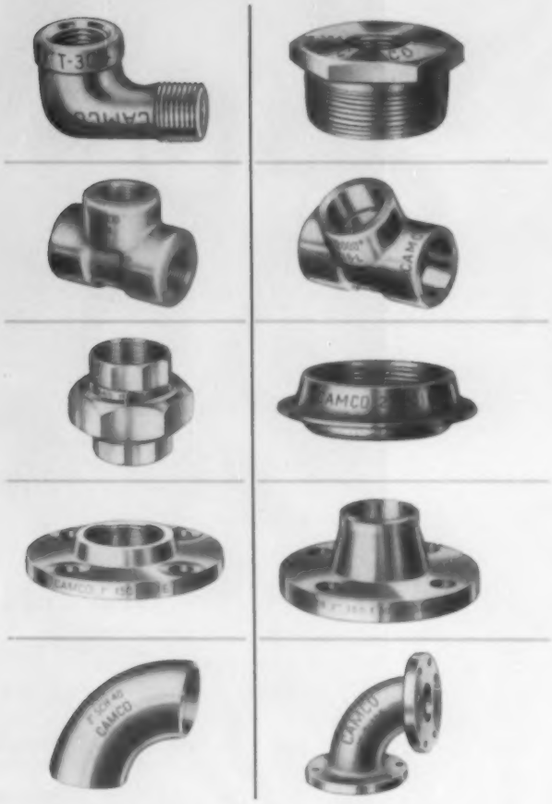
You buy the *Skill* and *Know-How* of *SPECIALISTS* when you purchase

CAMCO

STAINLESS STEEL PIPE FITTINGS



THE *Quality* LINE IN STAINLESS



The experience and facilities of Camco are devoted entirely to Stainless . . . insuring a quality product.

Shown are a few of the wide range of Stainless Fittings available from stock.

- **SCREWED END FITTINGS** 150, 2000, 3000 and 6000 LB.
- **SOCKET WELD FITTINGS** 2000, 3000, 4000, and 6000 LB.
- **FLANGES TO MSS STANDARDS** 150 LB.
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- **BUTT WELD FITTINGS** Schedules 5, 10, 40 and 80
- **FLANGED FITTINGS** To MSS Standards for Corrosion Resistant Flanged Fittings

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we pay $1 a pound for dust!

Put down that vacuum cleaner bag . . . we're *not* starting a new home industry! You see, the dust we need is a very special kind. All particles must be of a known size . . . and each particle is measured in microns (as you know, a micron is 1/25,400 of an inch). You'd have to put forty microns together to see them with the naked eye.

At $100 per cwt., this dust is important to the contribution we make in fostering industrial growth. We use it in testing and developing filters. These filters provide standards of precision and cleanliness that would have been considered fantastic for commercial production just a few years ago. Using this special dust is just one example of the care and thoroughness that enables us to engineer filtration systems that we *know* will surpass customer requirements . . . that we *know* will perform in the field as well as they do in the laboratory.

Expressed in dollars and cents, this attitude at Purolator has come to mean that it costs less to buy a Purolator filter than to pay for the consequences of operating without one. These consequences may very well be an inferior product, a product that wears rapidly, or even a product that fails to perform at all.

Our job is getting tougher all the time. Leaders in every industry are constantly challenging us to unmask the unknown and provide a solution. But, we have applied our research, engineering skill, quality control and manufacturing facilities to the greatest number of difficult problems in more phases of industry. So it is logical that industry asks us for solutions to their most difficult filtration problems.

PUROLATOR

PRODUCTS, LTD.

320 Kipling Avenue, South, Toronto 14, Ontario, Canada

The best way to get the most for your tube steel dollar: *Ask the experts!*

This month's report is on: **2% CR.-MO.**

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200°F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS

Carbon	Sicromo 2	Sicromo 5S	18-8 Ti
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	16-13-3
DM-2	2½% Cr.-1% Mo.	Sicromo 7	25-20
Silmo	Sicromo 3	Sicromo 9M	25-12*
DM	4-6% Cr.-Mo.	18-8 Stainless	35-15**
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti	18-8 Cb	16-25-6**

** Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

THERE are probably several high temperature tube steels that will solve your heat, pressure, corrosion or oxidation problems. But there's only one that will give you the most for your tube steel dollar—the best life/cost ratio.

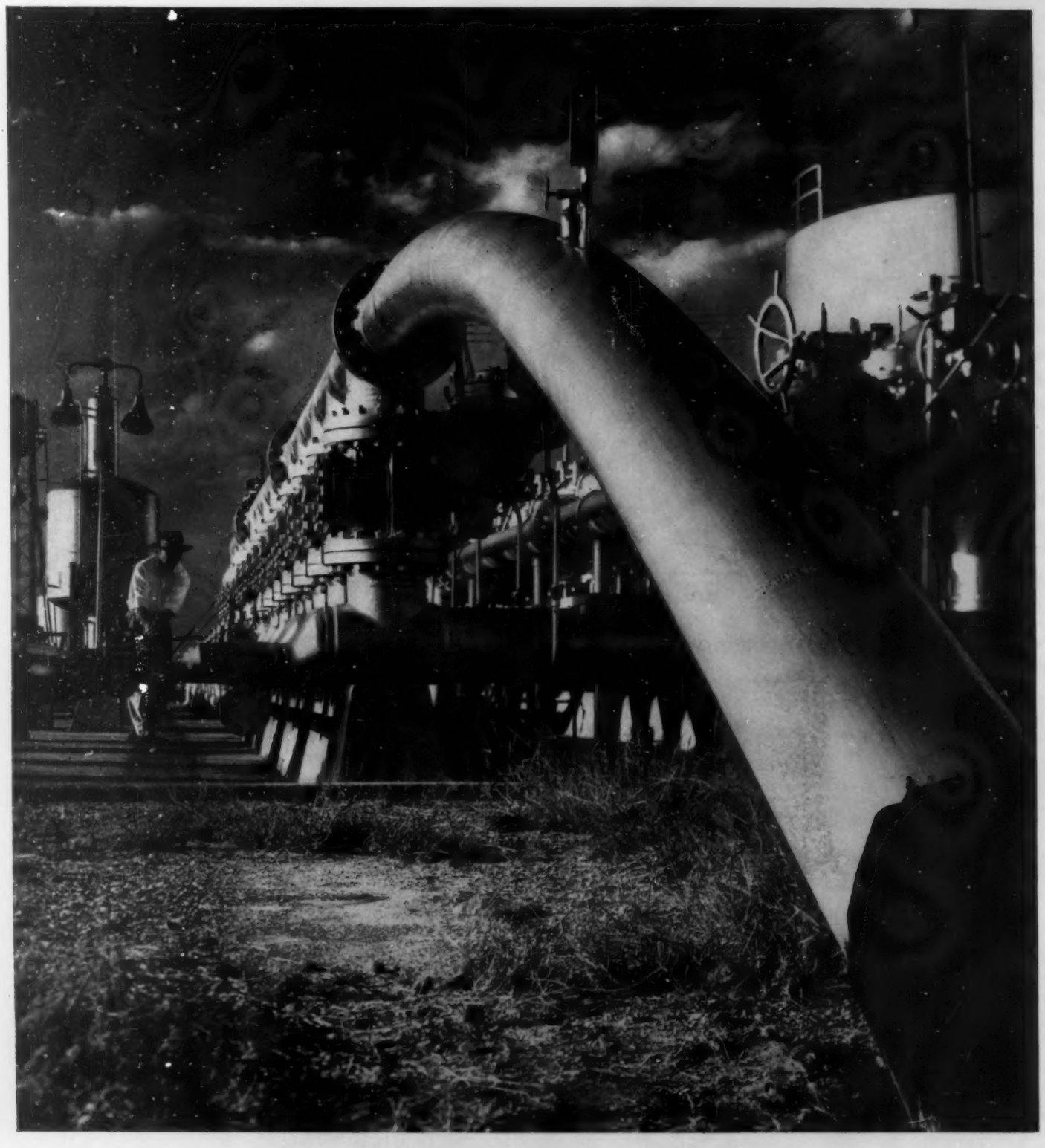
The best way to find it is to ask Timken Company metallurgists. They're recognized authorities on high temperature steels. With 23 years of experience behind them, they can help you select your best steel from 24 different analyses. You'll be sure of getting the most for your tube steel dollar. And you'll be assured of uniform quality in every tube because The Timken Company rigidly controls quality from melt shop through final inspection.

For help with your tube steel problems, *ask the experts!* The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This photo shows final tube inspection—last of hundreds of rigid tests that help account for the uniform quality of Timken high temperature steels.

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



"To keep pace with the growing demand for oil calls for tremendous capital investments. On the average, each new barrel of oil found and brought to market today requires an investment of about $4,000 and on that basis it does not take long to arrive at impressive investment figures . . ."

— M. J. Rathbone, President Standard Oil Company (New Jersey)

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STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

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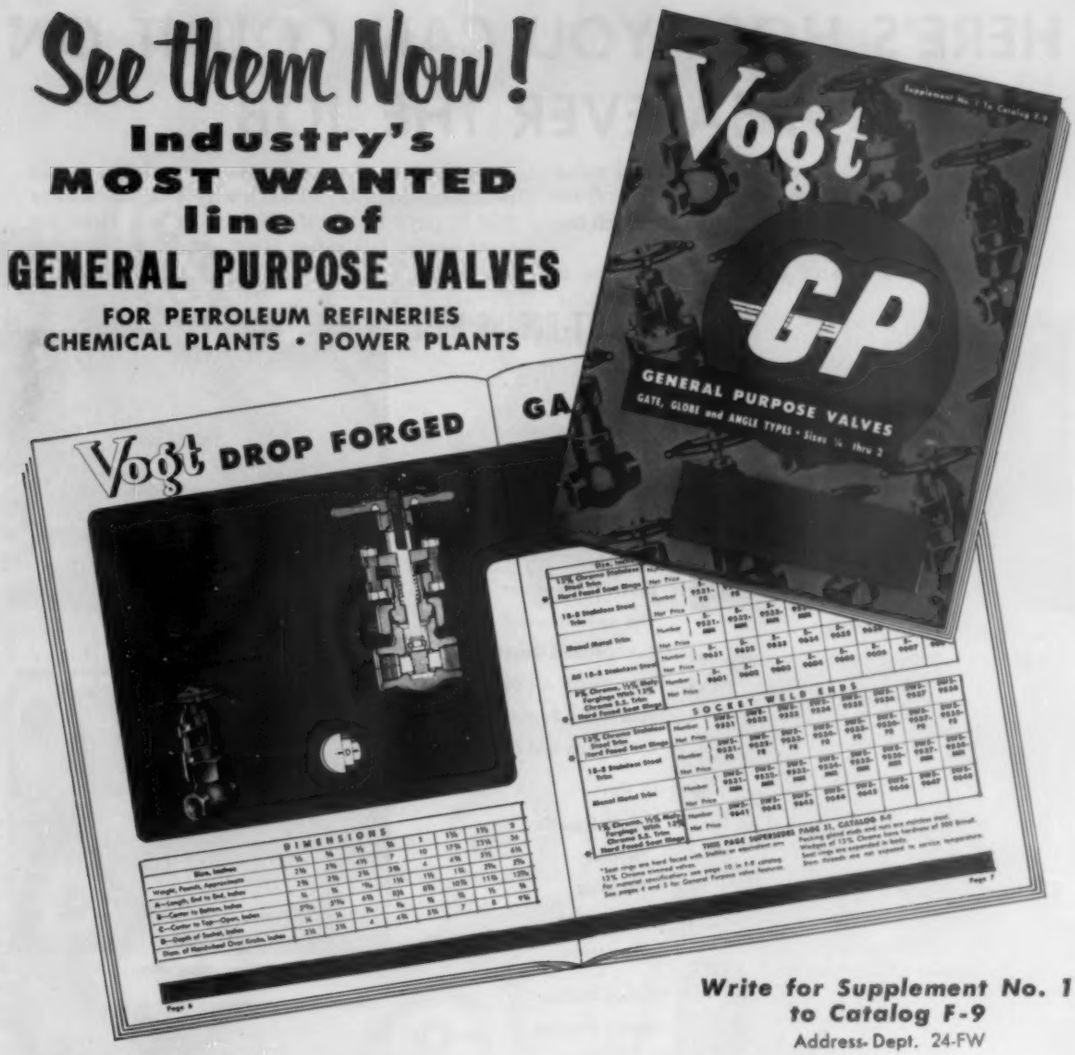

Write for Supplement No. 1 to Catalog F-9

Address- Dept. 24-FW

MOST WANTED — that's right — because the G P line includes gate, globe, and angle type valves having seats faced with **HAYNES STELLITE*** alloy or other hard facing alloys for greater seat-wear resistance . . . at no extra cost!

Hard faced seats, in combination with precision finished, selectively hardened discs and wedges give these valves amazing resistance to erosion, corrosion and galling. That's why they are setting new standards of performance in steam, water, oil, or gas services at the recommended pressures and temperatures.

Get longer, drop-tight, service life with minimum maintenance by specifying Vogt G P Valves. Available in a complete range of sizes from ¼" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

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DROP FORGED STEEL

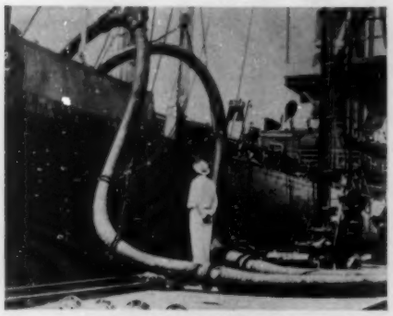
VALVES

*Trade-Mark of Union Carbide and Carbon Corporation

HERE'S HOSE YOU CAN COUNT ON WHATEVER THE JOB

When you need top hose performance and value regardless of the job, you can always count on Hewitt-Robins Hose. It's engineered to match the toughest operating needs.

The complete line of Hewitt-Robins Hose is recognized as the leader throughout the entire petroleum industry. That's why you will always find it pays to specify Hewitt-Robins Hose for your needs. It's safer, lasts longer and is more economical.



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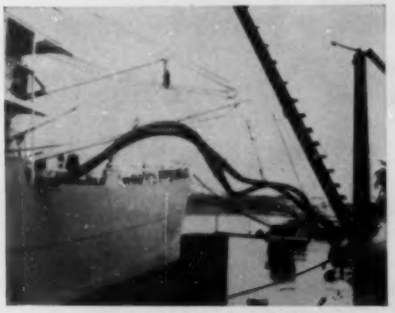

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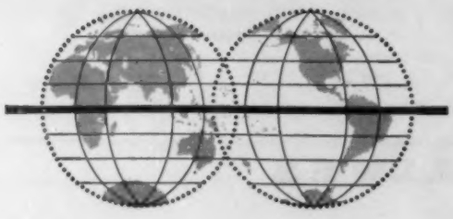

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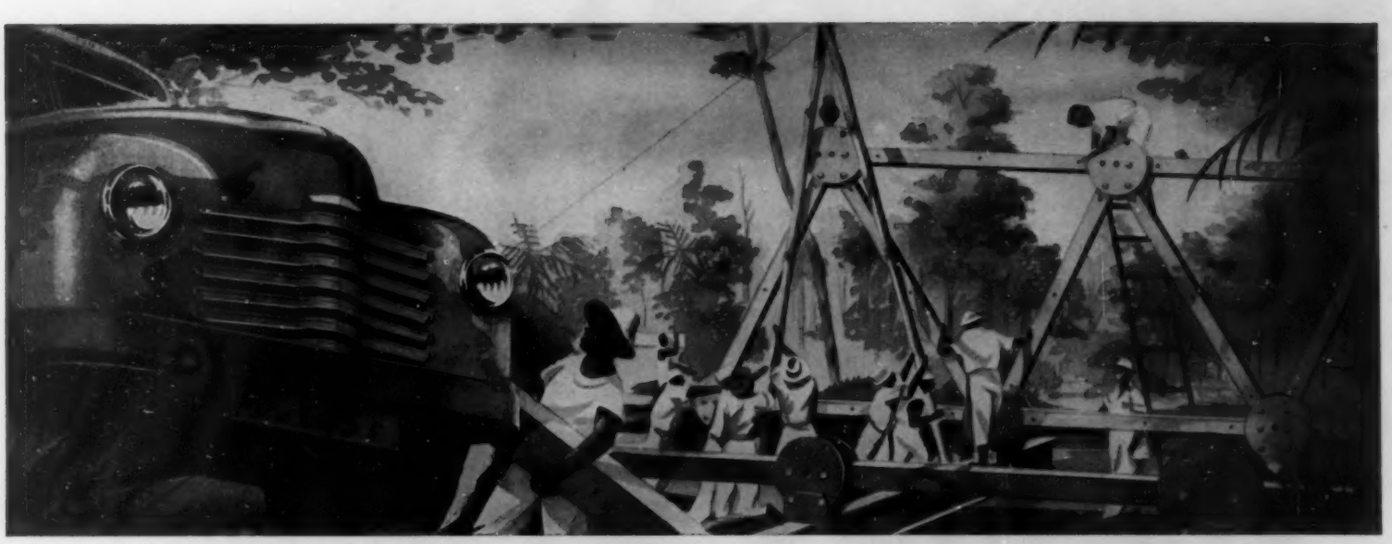
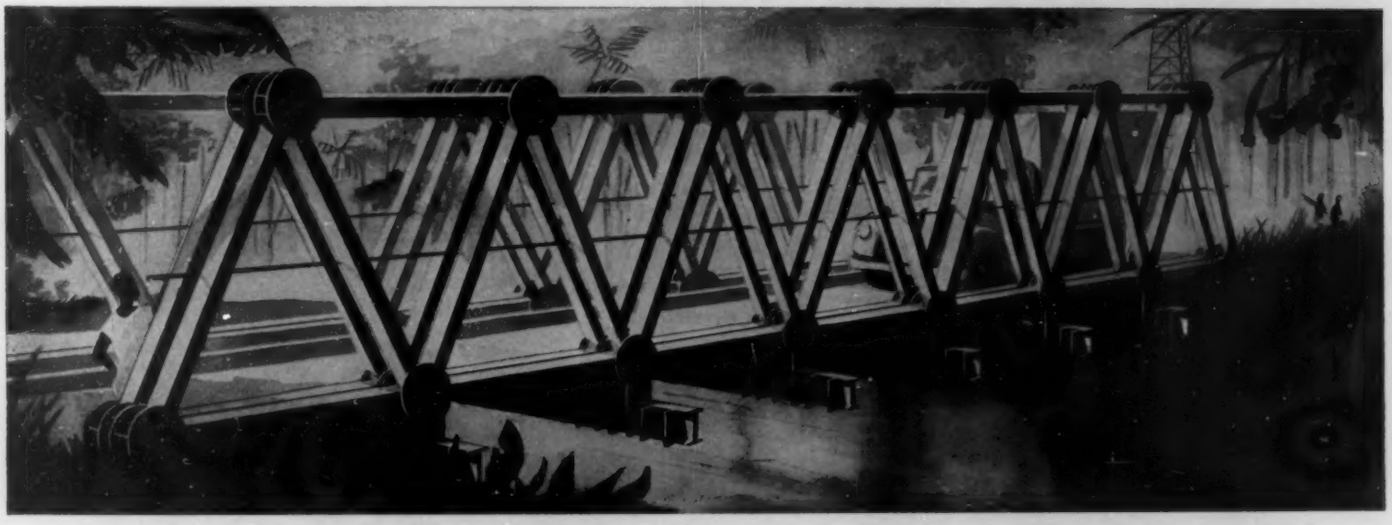
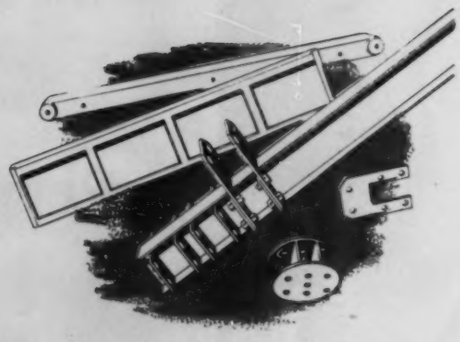


and quickly erected on . . .



remote up-country sites

Butterley Standard-Unit Bridges are in use all over the world where transport is difficult, skilled labour scarce or where site preparation has to be carried out under adverse conditions. From five standard units, all sizes of bridges can be built; the units can be sent by any form of transport; site erection is remarkably simple and swift with an absolute minimum of equipment.



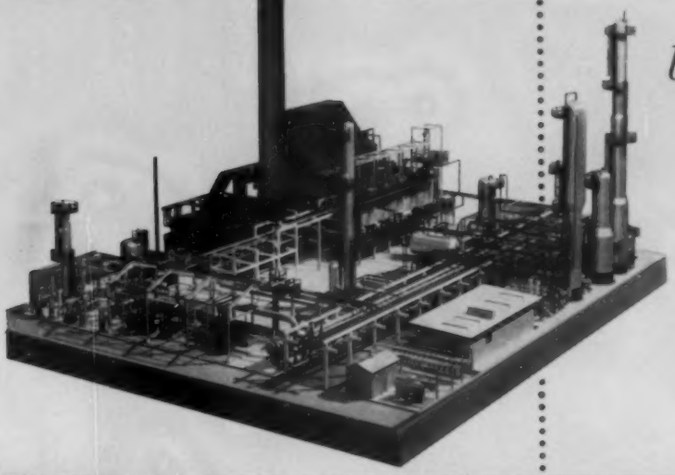
THE BUTTERLEY *STANDARD-UNIT BRIDGE*

THE BUTTERLEY COMPANY LIMITED RIPLEY DERBY ENGLAND

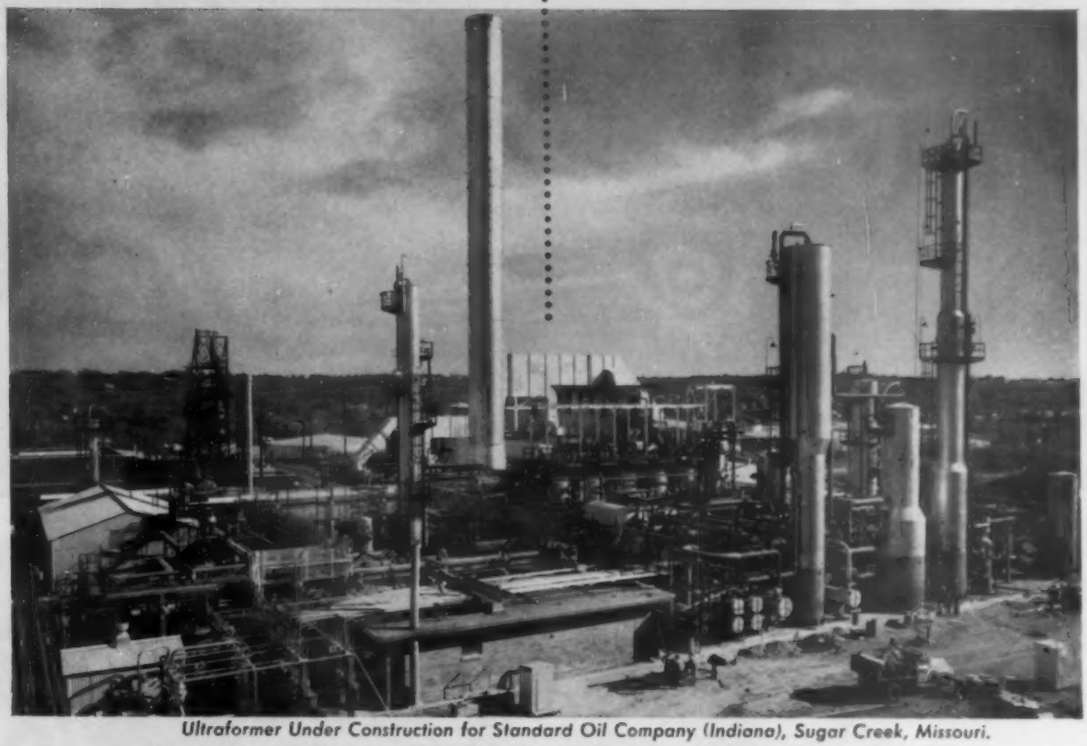
London Office: 9 UPPER BELGRAVE STREET S.W.1.

13 CATALYTIC REFORMERS

by PARSONS



Contracts for thirteen catalytic reformers have been awarded to Parsons. These plants range in capacity from 600 to 21,000 barrels per day and include regenerative and non-regenerative units using four different platinum-type catalysts. Process design, engineering, procurement, and construction of these catalytic reformers are by Parsons.



Ultraformer Under Construction for Standard Oil Company (Indiana), Sugar Creek, Missouri.

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GULF CRACKS THREE ETHYLENE FEED STOCKS INTERCHANGEABLY . . .

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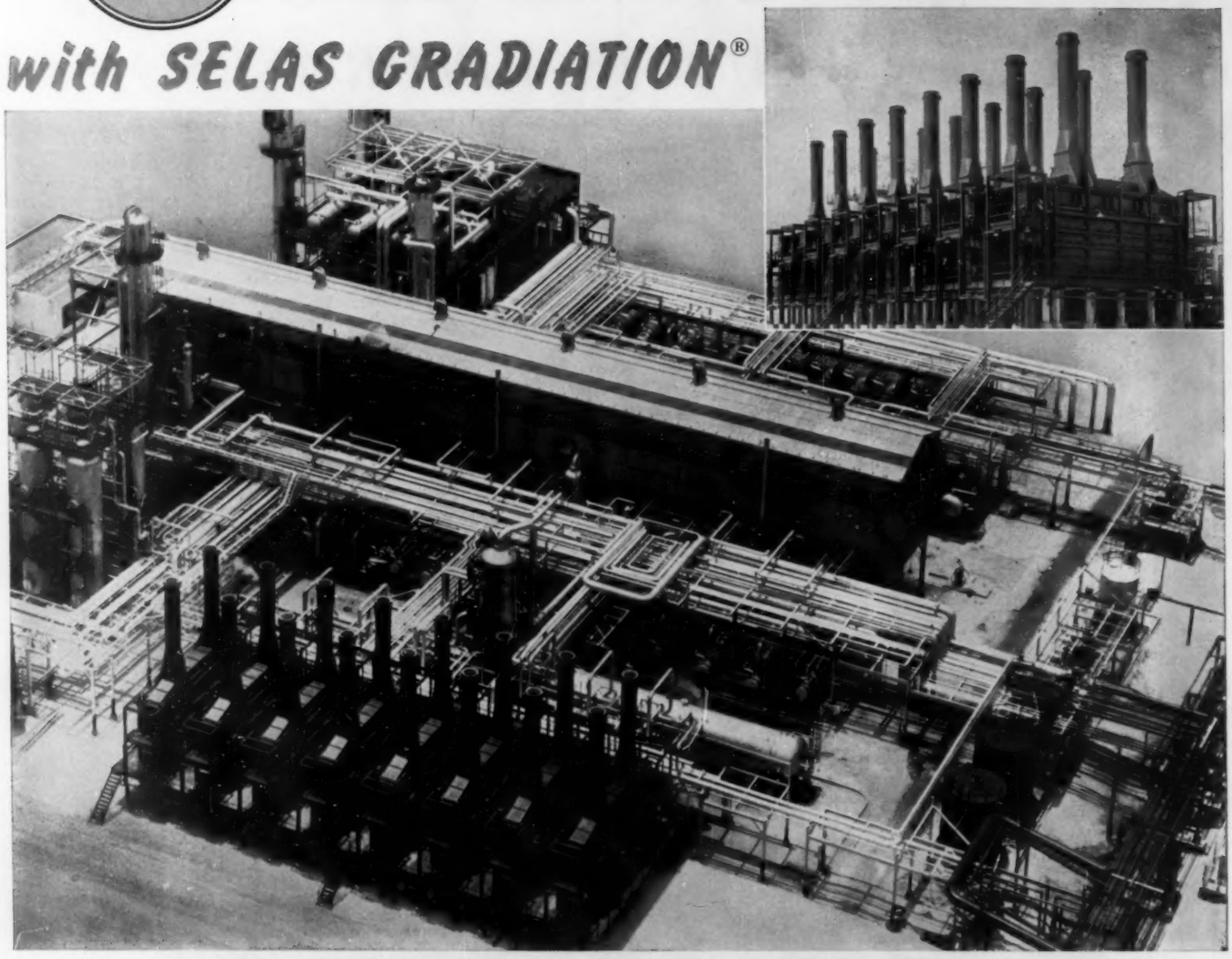

Gulf Oil Corporation's new ethylene plant at Port Arthur, Tex., designed and constructed by Stone & Webster Engineering Corporation. Eight Selas Gradiation heaters are in center foreground.

The world's largest ethylene-producing plant benefits from the versatility of Selas Gradiation heaters. Three separate feed stocks—propane, ethane and propane-propylene mixtures—have been processed interchangeably in all of the eight Selas furnaces.

Operating results on all three feed stocks in the Gulf plant confirm that these Selas heaters provide:

- "On stream" periods, without shutdowns, well in excess of 30 days.
- High conversions and selectivity.
- Optimum conditions, even with extreme variations in feed stock.

Zone control of heat input, enabling Selas heaters to meet any time-temperature curve in pyrolytic or catalytic reactions and high-temperature preheating, is featured by:

- Uniform heat distribution on the entire tube surface which extends tube life by eliminating local overheating and material degradation at the tube wall.
- Controlled combustion, with little or no excess air to cause external oxidation of the tubes . . . no lag in response to controller demand.

Send for copy of reprint, "Try the Gradiation Heater for Economical Ethylene Production" and Bulletin 105, "Gradiation Heating for Petroleum and Chemical Processing."

SELAS *Heat and Fluid Processing Engineers*
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DRESHER, PENNSYLVANIA
DEVELOPMENT • DESIGN • CONSTRUCTION

A PROGRESS REPORT ON OILMASTER DUAL ZONE PUMPING EQUIPMENT

TWO OIL WELLS FOR THE PRICE OF ONE

Until about four years ago, when our customers asked us about pumping two zones from the same well bore, we told them to forget it and drill a second well. However, with economics strongly favoring the dually completed single well, we were forced to change our minds.

The first Oilmaster Dual Zone pumping hookup was run in May 1953. It worked, but it fell short of being the tool we wanted. It did, however, point up the importance of having trained men in the field to design and supervise installations, and to assist in a program of research and development. A special division was formed, the tools were redesigned, and the product gained customer acceptance. This newly created Technical Service Division has been expanded as required to pace the increased demand of a broadening market.

Many changes have been made in the Oilmaster Dual Zone Pumping Equipment since 1953. The current models are less complicated —easier to run—easier to repair, and less expensive than old number one. But the biggest change has been in the diversity of models to handle varied pumping conditions. *Now it is possible to offer the producer every control in a dual well that is possible in a single well, including separating gas or treating paraffin or corrosive fluid in either or both zones.*

Want to hear more? Contact your nearest Oilmaster Representative or write Fluid Packed Pump Co., Box 64, Los Nietos, California, for complete information.

oilmaster PUMPS — FOREMOST IN THE INDUSTRY

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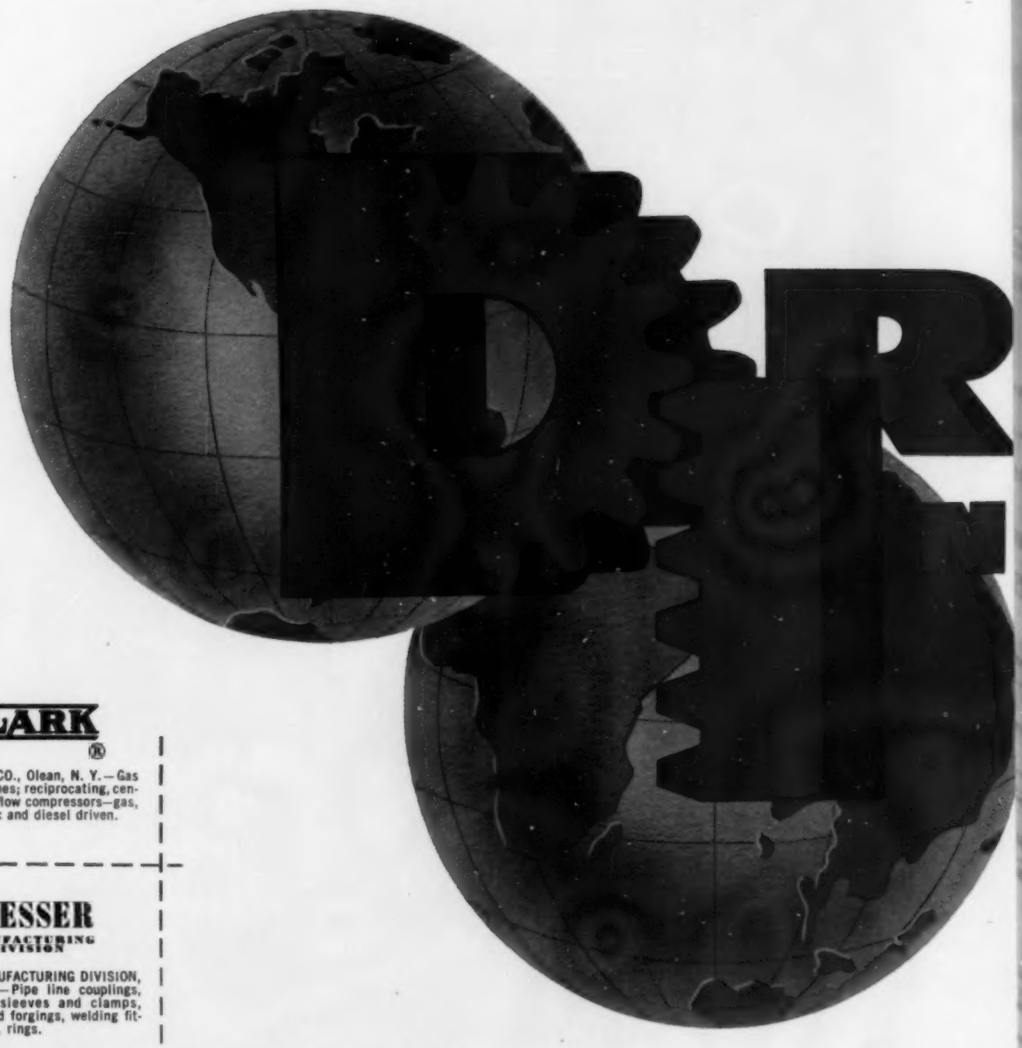

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CLARK BROS. CO., Olean, N. Y.—Gas turbines; engines; reciprocating, centrifugal, axial flow compressors—gas, steam, electric and diesel driven.

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DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments and forgings, welding fittings, flanges, rings.

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DRESSER-IDECO COMPANY, Columbus, Ohio—Radio and television broadcasting towers, steel buildings, aircraft hangars, mechanical parking garages, electric power substations.

IDECO®

IDECO, Dallas, Tex.—Hydrair* and Power Rigs; Full-View* Masts; substructures; single, dual and Drive-in Rambler Rigs; blocks, swivels, rotaries; mud-pumps; petroleum equipment and supplies.

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MAGNET COVE BARIUM CORP., Houston, Texas—Magcobar* and Magcogel* drilling muds and other specialized oil well drilling fluids and chemicals.

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PACIFIC®

PACIFIC PUMPS, INC., Huntington Park, Calif.—Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

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ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive and centrifugal blowers, gas pumps and exhausters; positive displacement meters and vacuum pumps; inert gas generators.

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The Dresser *Plus* + is more than a catch phrase. It's the personification of the basic business operating philosophy of independently-managed Dresser companies. The Dresser *Plus* + is another way of saying "teamwork." It's your assurance of a reputable world-wide source of equipment and technical services for the oil, gas, chemical and electronic industries.

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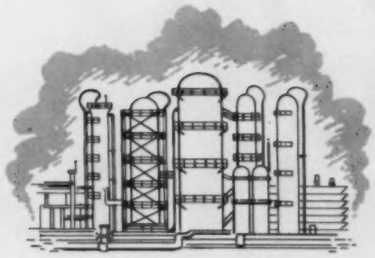

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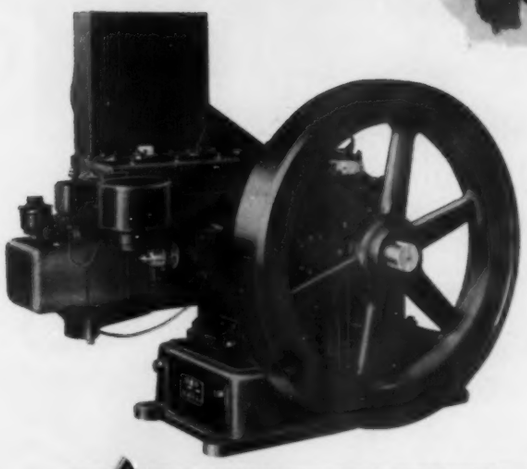

Whether Operating at High or Low Temperatures—Extremely Dry or Humid Conditions — CSCO Pumping Engines Need No Modifications or Special Equipment.

Only CSCO Engines have ALL 4 of these important features:

EASY AND SAFE TO START... A flip of release cam and flywheel momentum rides through the compression of combustible mixture. This is possible because the simple hand control cam holds inlet valve open (not exhaust valve), thus releasing compression. Therefore, the combustible mixture is allowed to charge the cylinder during free cranking.

SMOOTH, STEADY OPERATION... Flywheel inertia provides peak power while oil damped governor holds throttle steady — permitting engine to average demand, up to full capacity.

EASY TO SERVICE... There's no need to stop a CSCO to check or add oil... or water. Less shutdown for servicing.

EASY TO REPAIR... CSCO parts needing repair or attention can be removed with a minimum of disturbance of adjacent parts or assemblies.

CSCO Pumping Engines are available through supply stores other than Continental.

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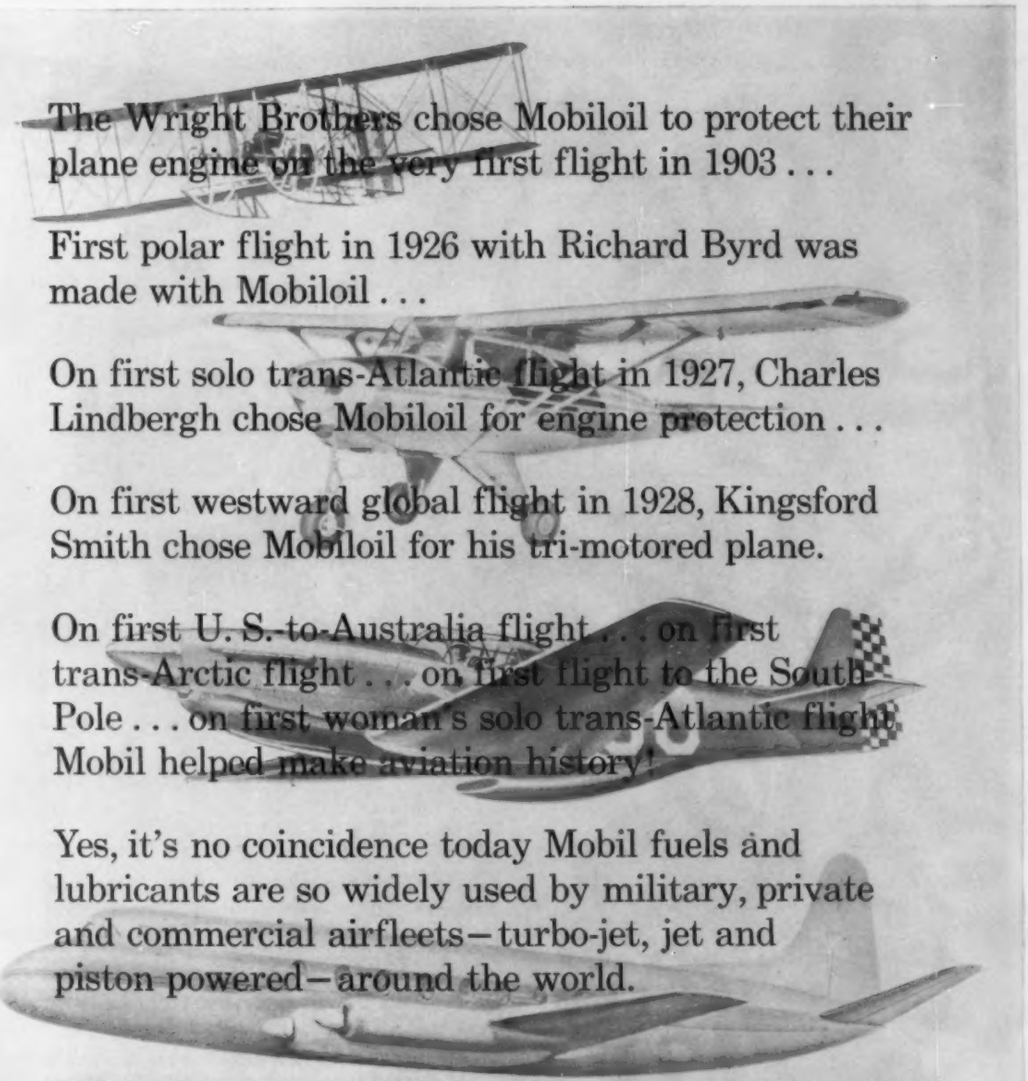
Representatives in All Principal Oil Fields of the World

The Petroleum Industry... Since 1859 Helping Make America Great

It's no Coincidence...



The Wright Brothers chose Mobiloil to protect their plane engine on the very first flight in 1903 . . .

First polar flight in 1926 with Richard Byrd was made with Mobiloil . . .

On first solo trans-Atlantic flight in 1927, Charles Lindbergh chose Mobiloil for engine protection . . .

On first westward global flight in 1928, Kingsford Smith chose Mobiloil for his tri-motored plane.

On first U. S.-to-Australia flight . . . on first trans-Arctic flight . . . on first flight to the South Pole . . . on first woman's solo trans-Atlantic flight, Mobil helped make aviation history!

Yes, it's no coincidence today Mobil fuels and lubricants are so widely used by military, private and commercial airfleets—turbo-jet, jet and piston powered—around the world.

Mobil Pays Off—in Progress, Performance and Protection

SOCONY MOBIL OIL COMPANY, INC.

and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

VISITORS to the Philippines see a land of rare beauty . . . tumbling waterfalls, quiet lakes, wide valleys, smoke-tipped volcanoes, sunny coastal plains and the breath-taking scenery around Baguio.

But even more inspiring is the sight of a free people busily building their new nation . . . 21 million of them spread over the 115,000 square miles which make up the land area of the 7,083 islands of the Philippines.

If the indomitable spirit and courage displayed by the Philippines people in withstanding the ravages of war are any indication, this new Republic is destined for a long and successful future.

Republic of the Philippines . . . with an abundance of rich farm and timberlands, mineral deposits, and surrounded by seas that teem with fish, these islands are also blessed with a warm and agreeable climate.

Today industry is taking its place alongside agriculture as the people of the Philippines energetically rebuild their shattered country toward a greater-than-ever peacetime stability with a better standard of living for all.

Standard-Vacuum is proud of the part its organization has played for half a century in supplying the petroleum products so essential to the welfare and continued growth of the Philippines.

STANDARD-VACUUM OIL COMPANY

A name that stands for "Progress" in the East

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A Better Diet for 300 Horses!

As automotive engines reach new horsepower and compression ratio heights, refiners must be ready with super-fuels necessary for their full measure of performance. After all, a diet made for 50 horses just won't do the job for 300.

For more than 40 years, Universal has made available to refiners everywhere new and more economical processes for producing the improved petroleum products needed to meet market requirements. These processes include:

CONTINUOUS THERMAL CRACKING, the first major improvement in refining methods, developed by UOP in the industry's early days.

POLYMERIZATION, a catalytic process developed by UOP and used to convert refinery waste gases into premium quality gasoline.

FLUID CATALYTIC CRACKING, developed to produce greater yields of liquid products and higher octane number gasoline.

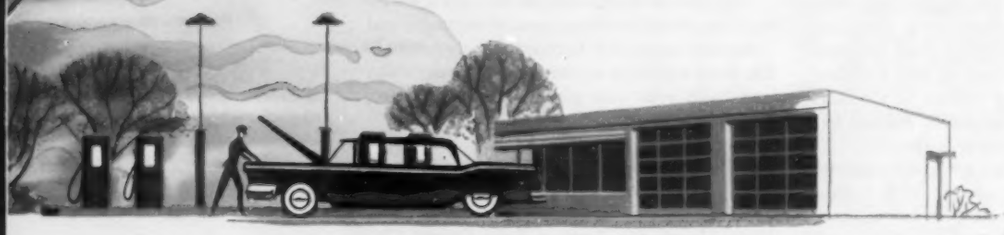
PLATFORMING, with which UOP pioneered the use of platinum in a reforming catalyst and originated the commercial designs of catalytic reforming units.

REXFORMING, a combination of UOP Platforming with solvent extraction which permits a refiner to produce even higher octane gasolines.

"HF" ALKYLATION, a process developed by UOP for producing alkylate, a high octane gasoline blending component, using hydrofluoric acid as the catalyst.

UNIFINING, the process which employs by-product hydrogen from UOP Platforming units to remove sulfur, nitrogen, oxygen and metallic impurities from petroleum distillates by catalytic hydrogenation.

These and other UOP processes, individually or collectively, can provide the answer to most refining problems. We will be glad to tell you how they can help with yours.



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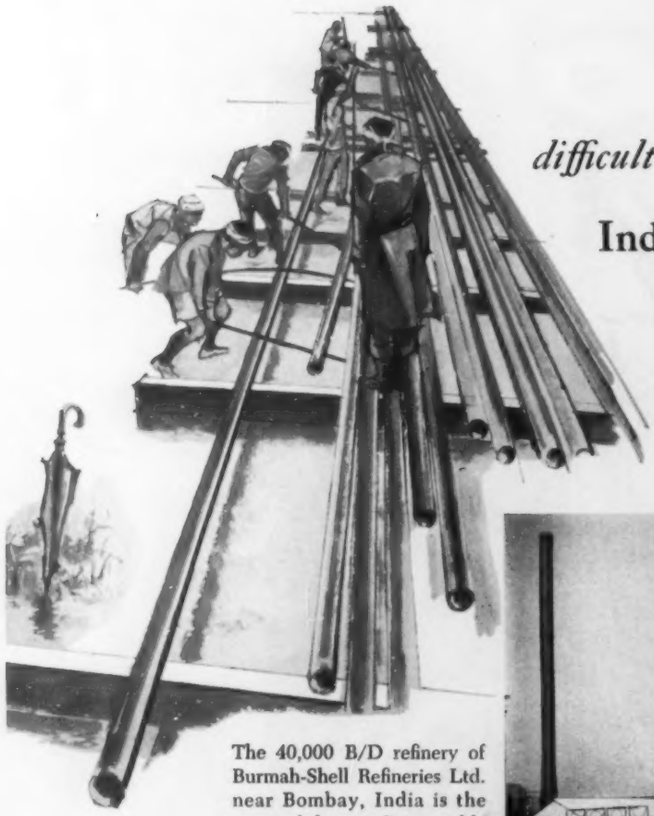
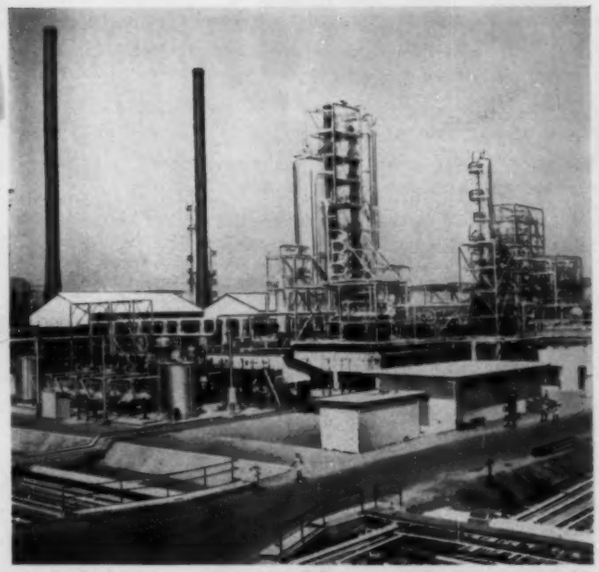


difficult physical conditions, but...

India's largest refinery was completed a year ahead of schedule



The 40,000 B/D refinery of Burmah-Shell Refineries Ltd. near Bombay, India is the country's largest. It is capable of supplying an estimated half of India's current requirements for finished petroleum. Although built in the face of difficult physical conditions, close cooperation with the owner in planning and engineering, and exceptional coordination of construction allowed Lummus to finish almost a year ahead of the original schedule.

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ENGINEERS AND CONSTRUCTORS FOR INDUSTRY

VOL. 27, NO. 5 MAY, 1956

World Petroleum

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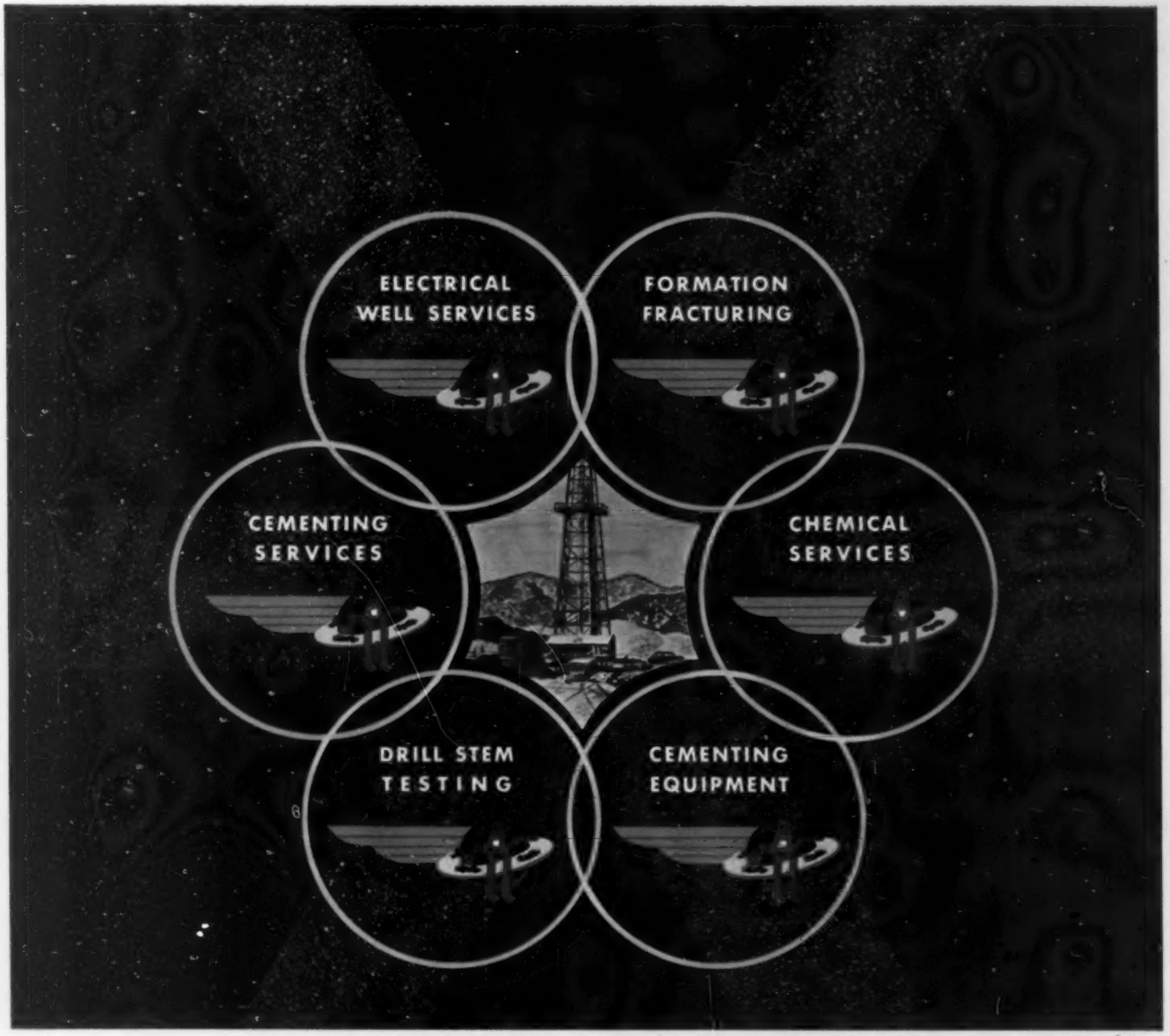
THIS MONTH'S COVER

Oil dramatically alters the pattern of golden wheat on the prairies near Edmonton. Color plates are from "The St. Lawrence Seaway—The Realization of a Mighty Dream," a brochure published by The House of Seagram, Montreal. The seaway is hailed by Seagram as a logical continuation of the work of the pioneers who first explored the new world.



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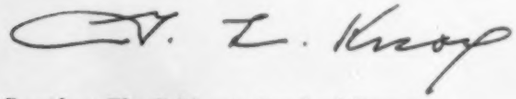
"PROGRESS IN SERVICE THROUGH RESEARCH"

Progress through competition

DURING 1956, the Canadian Oil Industry anticipates a continuation and accentuation of the progress made in 1955 in the fields of exploration, production, transportation and refining. The industry in 1955 enlarged proven oil reserves by a third of a billion barrels and proven gas reserves by two trillion cubic feet spending $440,000,000 in exploration and development. Two hundred and fifty drilling rigs and a hundred and fifty geophysical crews are now busy in an effort to further increase production and reserves this year.

Initiation of construction on a gas pipe line to Vancouver, progress towards a gas pipe line to eastern Canada and enlargement of oil deliveries to the Pacific Northwest are recent encouraging developments. However, the Canadian industry in its quest for markets needs every possible legitimate advantage. It is at an initial disadvantage in that the expense of moving oil from its chief producing areas to its largest potential markets is high compared with similar expense for competitive producing regions. Every effort is needed to reduce costs in order to enlarge markets and hence attract more investment capital.

The Petroleum Industry in Canada is now making approximately one-twelfth of the yearly capital expenditures for all industry in Canada. As a result, the energy derived from petroleum now accounts for well over a third of the total energy from all sources. This progress has been accomplished by private enterprise, involving intense competition between companies of all sizes and characters. In order to make the greatest contribution to the national progress this free competition must be continued in the future and industry, government and the general public must co-operate to keep costs low and thereby permit greater production through expansion of markets.



President, The California Standard Company.
Chairman of the Board of Governors of the
Canadian Petroleum Association.

◀ *Cutting trail for seismograph party. (Photo courtesy of Stanolind Oil & Gas Co.)*

General expansion characterized the industry during 1955. Demand rose 11 percent, with sharp rises in jet fuel and in aviation gasoline. Refining capacity rose 17 per cent. Crude and product exports rose also, to an estimated 53,000 b/d during the year. Self-sufficiency in oil grew by about 10 per cent to 58 percent of domestic needs covered by Canadian oil.

Recent Developments in Canadian Petroleum Industry

By W. D. Archbold[1] and R. M. Crockett[2]

THE largest gains ever recorded by the Canadian oil industry were achieved in all phases of the business during 1955. Domestic demand and refinery runs both increased by over 60,000 b/d to 620,000 b/d and 525,000 b/d, respectively. Crude oil and natural gas liquids production rose by more than 90,000 b/d to nearly 360,000 b/d.

Underlying this performance was a resumption of the rapid expansion of the Canadian economy, to which construction and investment in durable consumer goods were important contributors. These same factors were important to the growth in demand for petroleum products. As a result, Canada consolidated its position as the world's third largest petroleum consuming country; rose to fifth position as an oil refiner; and retained seventh place as a crude producer, despite the resumption of Iranian production. To make this level of operations possible about $650 million were spent for crude oil exploration and development, and manufacturing, marketing, and transportation facilities.

Demand—This striking overall performance was fully reflected in the 11% increase of crude and products demand. As a result, Canadian consumers used over two-thirds more petroleum than they had in 1950. The fact that higher levels of demand occurred in all areas and all products indicates the strength of the advance. (see Table I)

The greatest percentage growth occurred in the demand for aviation fuels as a result of the continually increasing air travel and defense activity. A milestone in Canadian aviation was reached during the year when Trans-Canada Airlines placed in service North America's first turbo-prop commercial aircraft.

Heavy consumer investment in durable goods during 1955 resulted in Canadian car manufacturers selling a record total of over 385,000 passenger cars. Truck and bus sales in excess of 80,000 brought motor vehicle sales close to the one-half million level. Since less than half of these new vehicles were replacing those withdrawn from use, there was a substantial 8% increase in the number of vehicles on the road.

Motor Vehicle Registration

	(000's) Cars	Total
1952	2,264	3,157
1953	2,486	3,432
1954	2,658	3,645
1955	2,882	3,841

This sharp increase in motor vehicles and higher levels of use of commercial vehicles were the major contributors to the 9% increase in motor gasoline demand. Higher

Motor Gasoline Demand

	(000's Bbls.)
1949	45,791
1950	49,988
1951	65,156
1952	62,511
1953	67,739
1954	70,933
1955	77,525

W. D. Archbald

R. M. Crockett

[1] *Head, forecast and statistical group, co-ordination and economics department of Imperial Oil Ltd.*
[2] *Assistant manager, co-ordination and economics department of Imperial Oil Ltd.*
Note: All figures for 1955 are estimated.

TABLE I—Canadian Crude & Products Demand

(Thousands of barrels daily)

	1950	1954	1955*	1955/1954 % Increase
Aviation Gasoline	5	7	10	31
Jet Fuel	.1	4	7	47
Motor Gasoline	137	194	212	9
Middle Distillates	87	162	183	14
Heavy Fuel Oil	80	109	116	6
Others & Loss	57	83	93	12
Crude & Products Demand	367	559	621	11

*Estimated

TABLE III—Progress Towards Self-Sufficiency

	Production(†) b/d	Needs b/d	% Sufficienty
1954	267.4	558.9	47.8
1955	361.8	621.0	58.3

(†) Includes natural gas liquids.

TABLE II—Canadian Supply and Demand for Oil

(Millions of barrels daily)

	1952	1953	1954	1955*
Demand				
Demand	473.7	520.0	657.9	670.0
Exports	6.2	7.5	9.0	49.0
Domestic Demand	467.5	513.5	558.9	621.0
Supply				
Crude Production	167.3	221.6	263.2	355.9
Other Production	3.0	3.4	4.2	5.9
Crude Imports	225.3	223.0	210.3	239.2
Product Imports	93.4	98.2	98.9	102.0
Total Supply	489.0	546.2	576.6	703.0
Inventory				
Stock Changes	+15.3	+26.2	+ 8.7	+33.0

*Estimated.

agricultural activity, compared to the depressed level of 1954, was also important in this gain.

Power burner manufacturers also had a successful year, selling a record total of nearly 160,000 burners. Continued installation of substantial numbers of oil-fired space-heaters were also made. As a result, a dominion government survey in September, 1955, indicated that there were 1,656,000 oil-heated homes in Canada, compared with 1,417,000 a year earlier. The 1955 total represents nearly 45% of the country's households. At the same time, the nation's railroads accelerated their various programs for changing from steam to diesel power. At the year end, this task was nearly one-half completed. This rapid expansion in domestic heating and in railroad use provided the impetus for a 14% increase in middle distillate requirements.

Distillate Fuel Consumption

	Oilheated Homes (000's)	Consumption Store Oil (000's Barrels)	Consumption Furn. Fuel (000's Barrels)
1950	633	7,197	14,152
1951	774	9,038	18,389
1952	944	9,070	24,511
1953	1,260	10,092	27,622
1954	1,417	12,185	35,016
1955	1,656	12,606	38,510

The effect of rapidly rising industrial requirements for heavy fuel oil, as well as greater international shipping demands, was partially offset by a small decline in railroad use. The railway dieselization programs so far have resulted largely in reduced use of coal, but for the last two years small reductions in heavy fuel use have also occurred. These various factors combined to yield a 6% increase in heavy fuel oil demand.

Heavy Fuel Oil Demand

	(000's Bbls.)
1949	24,520
1950	29,106
1951	34,578
1952	35,909
1953	38,845
1954	39,817
1955	42,210

Demands for the various smaller volume products increased some 12%. The large new aluminum plant at Kitimat, British Columbia provided a marked growth in petroleum coke demand. New petrochemical plants and the expansion of older ones meant greater volumes of petroleum raw materials for this young industry in which about $250 million has been invested in the last few years. The marked growth in Canadian refinery and pipe line operations brought with it a large fuel requirement which also contributed to the demand increase.

This brief description has indicated the extent to which the increases achieved in 1955 oil demand were distributed among the various products. These results brought demand in 1955 to a level nearly 70% greater than that experienced five years earlier. In that period, aviation fuel requirements tripled, middle distillate demand doubled while motor gasoline and heavy fuel oil reached demands one-half greater than those of 1950.

Regional Crude and Products Demand

(Thousands of Barrels Daily)

	1950	1954	1955	1955% of Total
Brit. Columbia	44	60	67	11
Prairies	77	124	140	22
Ontario	121	189	206	33
Quebec	90	137	153	25
Atlantic Provinces	35	49	55	9
Canada	367	559	621	100

The regional distribution of demand in 1955 is shown in the above table. It is apparent that the increases in demand last year were well distributed regionally as well as among the various products. It will also be noted that one-third of the country's oil market is in highly industrialized Ontario, about one-quarter in each of Quebec and the Prairie provinces, with the remainder fairly equally distributed between the two coasts. Since crude oil from the Prairie oil fields serves refineries in Ontario and British Columbia, two-thirds of Canadian demand could be considered to be within the present orbit of domestic crude oil.

Refinery Operations—Before discussing the extent to which domestic crude oil has filled this potential requirement, a brief outline of 1955 refinery operations might be useful. Canadian refiners continued to supply about 85% of the country's requirements through crude processing.

Refinery Crude Runs

(Thousands of Barrels Daily)

	1950	1954	1955	1955/1954 Increase
Brit. Columbia	22	41	50	22%
Prairie Prov's	72	122	133	9%
Ontario	69	121	134	11%
Quebec	113	164	193	18%
Atlantic Prov's	22	17	17	——
Canada	298	465	527	13%

An additional 2% was supplied by blending at refineries and by field plant production of LP Gas and natural gasoline. The remaining requirements were met from product imports.

The Prairie provinces are self-sufficient with the exception of small volumes of aviation gasoline and specialty products. The balance of the area's requirements come from field plant production. British Columbia refiners supply the area's entire gasoline requirement, but high distillate and residual demands require some import support, as do specialty products. East coast demands are supplied largely from imports and shipments from Quebec, with the one refiner in the area accounting for about one-third of the region's needs.

Ontario and Quebec provide the significant supply situation. It will be noted that Ontario refiners supply only two-thirds of the province's requirements, while Quebec refinery production is greater than provincial demand. This is in part influenced by the location of about 10% of Ontario demand adjacent to refineries in Montreal, Quebec. It is to a greater extent, however, the reflection of the virtually total dependence on imported crude in the early post-war years of rapid refinery expansion, and the consequent construction of basic capacity in the Montreal area. When the two provinces are considered jointly, their refin-

ery operations are equal to about 80% of demand in the combined area. High distillate requirements for heating, and substantial heavy fuel oil demands for industry require substantial volumes of supplementary imports.

It will be noted that the refiner's ability to meet the country's entire fuel product requirements is limited by the ability to produce fuel oils. Each year, however, further increases in middle distillate yields have been achieved, enabling refinery operations to increase more rapidly than demand and narrow the import gap. The 14% increase in 1955 is further evidence of this trend.

Refinery Capacity—This has required substantial additions to refinery capacity in all areas. The emphasis has been on the interior, however, as a result of the availability of domestic crude in previously high-cost import areas. The extensive construction programs of 1955 added 81,000 b/d or 13% to bring total capacity to 646,000 b/d at year end.

Refinery Capacities—Year End
(Thousands of Barrels Daily)

	1950	1954	1955	1955/1954 Increase
Brit. Columbia	28	54	64	18%
Priarie Provinces	85	159	176	11%
Ontario	75	141	153	9%
Quebec	137	180	235	30%
Atlantic Provinces	22	18	18	——
Canada	347	552	646	17%

Included in this increase are several new refineries. Projects currently under way will add 24,000 b/d to Atlantic Province capacity, and a similar amount in Ontario. No large-scale capacity expansion programs are in progress in other areas at this time.

Refinery Crude Oil Supply—In recent years, crude oil for Canadian refineries has come increasingly from domestic sources.

Refinery Crude Oil Supply
(Thousands of Barrels Daily)

	1950	1954	1955	1955/1954 Increase
Domestic	72	255	291	14%
Imported	226	210	236	12%
Total	298	465	527	13%

In 1950 less than 20% of the crude oil processed was domestic. By 1954, the proportion had risen to 56%, but in 1955 increased only slightly as a result of the large increase in Montreal refinery operations. With Canadian crude oil available to all refiners from Ontario to the Pacific Ocean, it is expected that further increases in the utilization of domestic crude will result in a slight rise in this proportion. As a result, crude oil imports which have been quite stable for several years, might be expected to continue to rise, as they did in 1955.

Product Imports—Product imports in 1955 were slightly more than 90,000 b/d, about the same as those in 1954. Nearly half of this volume was made of middle distillates, one-quarter of heavy fuel oil, and the balance distributed among aviation and motor gasolines and the various small volume specialty products. With the demand for middle distillates continuing to outpace that for gasoline, imports may be expected to grow, with increasing emphasis on middle distillates.

Crude and Product Exports—Canada's petroleum export trade is a very recent development. Five years negligible volumes of products and no crude oil were exported. In 1955, product exports amounted to about 3,000 b/d and crude oil exports exceeded 50,000 b/d. The product exports were largely gasoline from West Coast refiners to the Far East and the U. S. There is a possibility that this trade could experience some further modest growth.

However, it is crude exports which hold the greatest promise. At year-end, they were exceeding 100,000 b/d and further growth is expected. Two refineries in the Puget Sound area of Washington, two in the Minneapolis/St. Paul area, two near the head of Lake Superior, and one in Michigan were receiving pipe line supplies of Canadian crude at the end of 1955. In addition, several cargoes of crude were shipped on a spot basis to California early in 1956. Further refinery construction plans have been announced for the Puget Sound area, providing additional potential markets.

Of particular significance in 1955, however, was the construction of a pipe line from the Interprovincial Pipe Line system at Clearbrook, Minnesota, to the Minneapolis/St. Paul area. This line not only brought two new refinery customers for Canadian crude but at the same time provided an outlet for medium gravity Saskatchewan crude. Markets for this crude had previously been limited by the lack of refineries equipped to process it.

Crude Oil Production—These various supply and demand factors are to some extent summed up in domestic crude production. An increase of 37,000 b/d in Canadian markets, 48,000 b/d in export markets, and small volumes for inventory provided an increase of 90,000 b/d to a level of 356,000 b/d for the year. Natural gas liquid production increased by one-half to 6,000 b/d for a total production of 362,000 b/d.

Crude Oil Production
(Thousands of Barrels Daily)

	1950	1954	1955	1955/1954 Increase
Crude Oil	79	263	356	35%
Natural Gas Liquids	1	4	6	50%
Total	80	267	362	36%

TABLE IV—Production of Crude Petroleum

	1955 (Millions of b/d)	1954	% Increase
Alberta	309.7	240.3	28.9
Saskatchewan	31.9	14.8	115.5
Manitoba	11.4	5.8	96.6
Northwest Territories	1.1	1.0	10.0
Ontario	1.4	1.1	27.3
New Brunswick	0.4	0.3	33.3
CANADA	355.9	263.3	35.2%

This production was over four times the 1950 average, and 35% greater than 1954.

Crude Oil Exploration and Development—In large measure, the uniformly good results achieved in all phases of the Canadian oil industry in 1955, and earlier years, can be related to the availability of domestic supplies of crude oil. These supplies in turn are contingent on the effort expanded by the industry in exploration for and development of crude reserves. Despite rapidly increasing annual production, remaining proven reserves have continued to increase by 250/300 million barrels a year. This was achieved again in 1955, with remaining reserves growing by over 300 million barrels to about 2.5 billion at year end.

Drilling activity in Western Canada during 1955 can be briefly summarized by two phrases, the tremendous upsurge in development well completions, and the outstanding exploratory successes in southeastern Saskatchewan.

Development drilling increased by 50%, to a record level of 2,043 wells. Completions in the Pembina field mainly accounted for the increase where 642 wells were placed in production during the year. The Joffre-Burbank and Sundre-Westward Ho areas of west central Alberta also continued active development. Drilling is also getting deeper, being over 400 feet per hole deeper than in 1954.

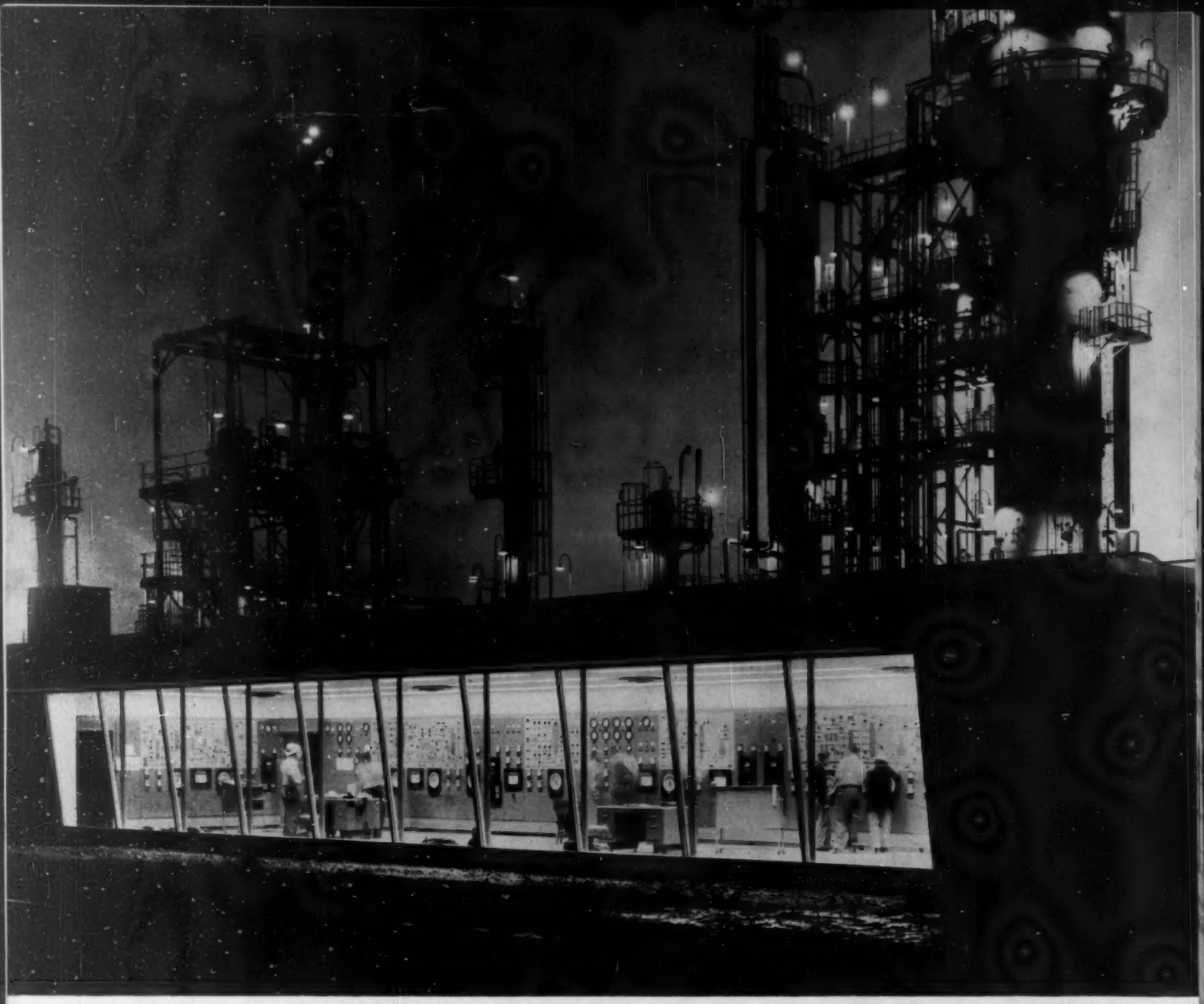
Exploration activity in southeastern Saskatchewan is being spurred on by an increasing number of oil discoveries and extensions. During the year the industry found 20 new oil fields in the area and made 8 successful extensions to fields previously discovered. Exploration activity continued throughout the entire basin, although drilling declined about 5% from 1954 levels.

Industry Drilling Completions—Western Canada

	1954	1955	Inc. % (Dec.)
Development Drilling	1,375	2,043	50
Exploratory Drilling	907	863	(5)
Total	2,282	2,906	27

As in the development phase, exploration drilling was deeper during 1955, averaging about 400 feet per hole deeper, reflecting an increasing emphasis toward exploration in the western portions of the Western Canadian basin.

There is indication that 1956 will continue the accomplishments of 1955 and the post-war period. Demands for petroleum products are expected to essentially repeat the gains of last year, refinery operations will rise to meet these growing requirements, with product imports continuing to supply fuel oil and specialty product deficiencies. Expansion of markets for Canadian crude will provide for substantial increments of crude production. Exploration and development activity in Western Canada should continue at their present high levels. All of these activities insure the continued investment of an amount in excess of $500 million by the Canadian oil industry during 1956.



Integrated control room at the St. Boniface, Manitoba, refinery of North Star Oil Ltd. This new refinery, with a capacity of 12,000 b/sd, was completed in July, 1955.

OIL REFINING IN CANADA

The octane race in Canada is complicating the job of keeping ahead of booming demand. Catalytic reformer construction as well as crude still expansion continues active.

CANADIAN refining capacity increased 15% in 1955 to 650,850 barrels daily. The increase of 84,450 b/d was almost equally divided between Quebec and the remainder of the Dominion.

Construction during the year brought capacity roughly in line with domestic demand for petroleum products which is estimated to have averaged 623,000 b/d. The capacity as stated was not available until toward the end of the year however. Actual refinery output averaged about 530,000 b/d, requiring continued importation of substantial quantities of refined products.

With another large increase in consumption forecast for 1956 refiners find it necessary again to increase their still capacity. Current projects now under construction or planned for an early start total 97,500 b/d. Some of this new capacity will supplant obsolete equipment but it now is indicated that the industry will be able to run 730,000 b/d by the end of the year or early in 1957.

Major projects which will supplement present crude capacity include Imperial Oil's new 45,000-barrel plant at Halifax, a new 30,000-barrel unit at British American's Clarkson, Ont., refinery, a 10,000-barrel project by Shell at Montreal, a further increase of 6,000 barrels by Regent and 5,000 barrels by Canadian Oil Companies.

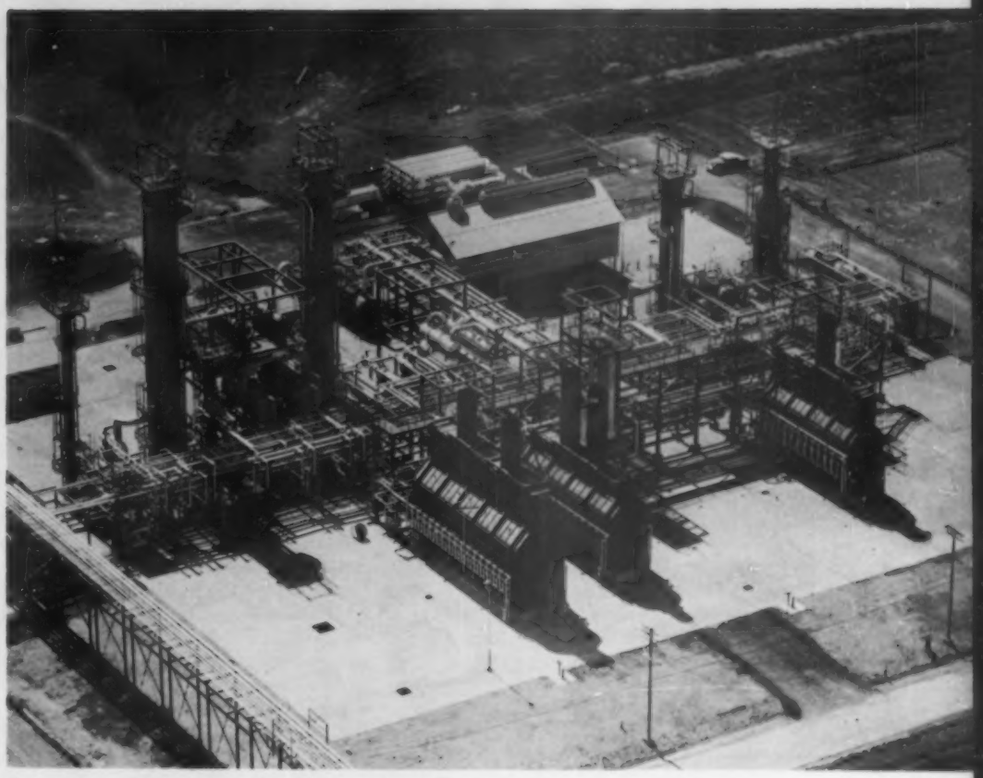
Since the end of World War II refinery capacity on the Pacific Coast has tripled. On the Prairies the expansion has been more than fourfold. Ontario and Quebec have more than doubled their capacity. Details of growth by areas are shown in Table I.

The recent spectacular rate of increase in demand for oil in Canada is attributed both to the steady increase in population and to the boom in industrial and mining activity and the expansion of demand for forest products. Prior to World War I per capita oil consumption in Canada was only half that in the United States, averaging 4.7 barrels per year compared with 9.4 barrels. By 1954 Canadians were consuming 13.4 barrels per capita per year and U. S. consumers 17.6 barrels per year.

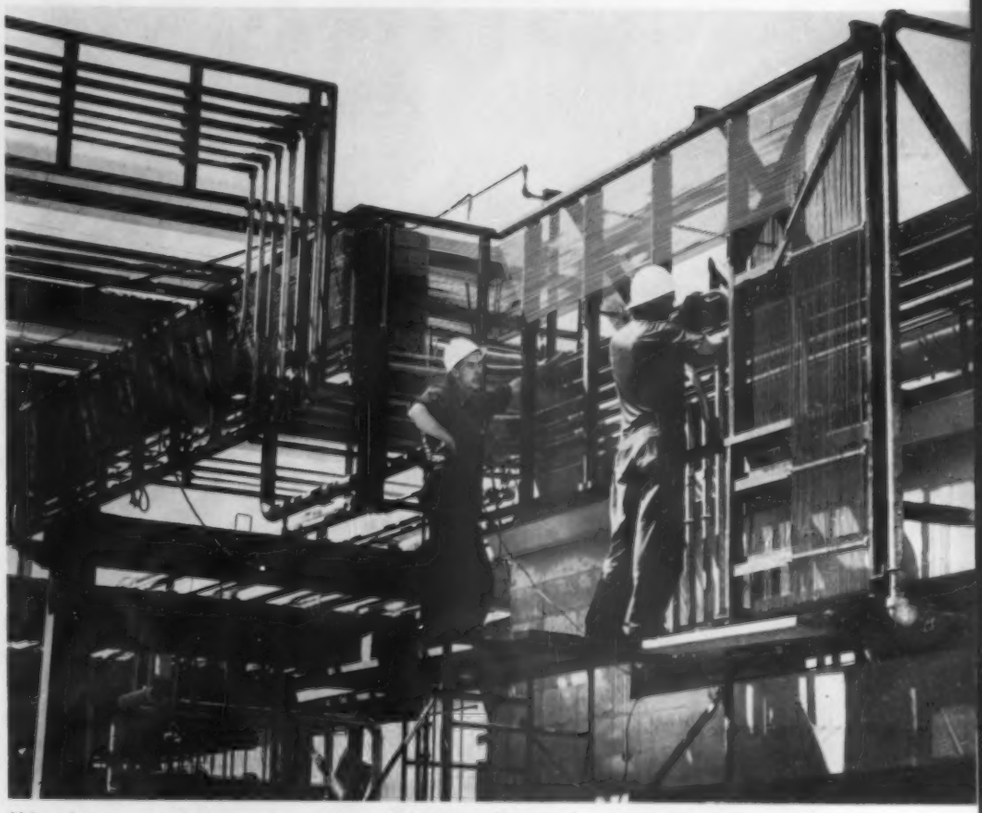
In a recent report to the Royal Commission on Canada's Economic Prospects Imperial Oil Ltd. estimated that petroleum demand in Canada will rise from 623,000 b/d in 1955 to 808,000 b/d in 1960 and to 1,753,000 b/d by 1980. This means, of course, that the industry will continue to require a very large investment in new refining facilities each year during the next quarter of a century.

The octane race in Canada is becoming as hectic as in the United States. Result is that the installation of catalytic reforming units now is proceeding at a rapid pace.

British American completed a 2,000-barrel Catformer at Calgary in 1955 and in February of this year activated a 13,000-barrel unit at Montreal. At Clarkson where a new 30,000-barrel crude still is being built B-A is installing a 10,250 b/d Catformer.



General view of the Platformer at the Montreal refinery of McColl-Frontenac Oil Co. Ltd.



Miles of instrument piping run through Imperial Oil's Ioco, B. C., refinery leading to the control house. (Photo courtesy of Imperial Oil Ltd.)

Imperial Oil Ltd. built a Powerformer at Edmonton last year and now is building similar units at Pacific, central and eastern plants. The Edmonton unit, the first of its kind, has a capacity of 2,000 b/d. At Ioco, B. C., the unit will have a capacity of 3,300 b/d when complete. At Sarnia a 13,500 barrel unit is scheduled for completion in September. Montreal will have a unit with a capacity of "more than 8,000 b/d." Imperial's refinery building program for 1956 will represent an investment of $125 million, President J. R. White has announced.

Regent completed a Platformer of 2,300 b/d capacity in 1955 and Canadian Oil Companies built the first Platformer in Canada several years ago with a capacity of 4,500 b/d. Recently the company obtained through merger the Anglo-Canadian refinery at Brandon, Man. which completed a 1,200 old Platformer last June.

McColl-Frontenac also is in the midst of a major product improvement program. At Edmonton a Platformer with a capacity of 3,300 b/d is being built. Completion is planned for November. At Montreal a new Platformer is under construction with a Unifiner for processing high sulfur naphthas. Capacity of the reformer will be 12,000 b/d. Recent work at Montreal includes a re-vamping of the cat cracker to increase capacity. Coke burning capacity has been enlarged from 11,000 to 15,000 lb/hr and throughput stepped up from an original 12,500 to 21,000 b/d.

TABLE 1—RATED REFINERY CAPACITY (Barrels per day)

Year	B. C.	Prairie	Ontario	Quebec & Atlantic	All Canada
1939	22,700	35,570	44,500	97,250	200,000
1946	21,800	40,815	77,950	105,300	245,865
1951	28,850	120,700	79,400	182,300	411,250
1952	29,850	130,450	105,800	182,300	448,400
1953	45,850	150,100	129,500	209,300	534,750
1954	53,500	162,600	141,000	209,300	566,400
1955	64,000	179,550	156,000	251,300	650,850

Shell Oil Co. of Canada is building two Platformers as part of a major refinery construction program. A 6,600 b/d Platformer will be completed about mid-year at Montreal and a 3,300 b/d unit will be ready at an early date at North Burnaby, B.C.

Also, on the West Coast, Standard Oil Co. of British Columbia, Ltd., completed a 2,750 b/d Platformer last year. Crude capacity of the North Burnaby plant was stepped up from 11,500 to 16,000 b/d in 1955. New treating facilities for stove oil will be installed this year.

At nearby Kamloops, Royalite Oil Co. operates a 3,500 b/d Platformer.

In the Peace River district in northern British Columbia, North Star Oil, Ltd. is building a 2,500 b/d refinery at Grand Prairie. An older refinery is being moved to this site from St. Boniface and a catalytic reformer is being added. It is anticipated that the plant will be ready for operation by July, bringing British Columbia capacity up to 66,500 b/d..

The Grande Prairie plant will include a 2,500 b/d crude unit, 1,100 b/d Dubbs thermal cracker, and a 438 b/d Sinclair-Baker catalytic reformer. Control for all units will be integrated in a single control room. Steam plant will have a capacity of 50,000 lb/hr. Storage will be provided for 250,000 barrels of products. Truck and tank car loading facilities are being erected together with the usual administrative and machine shop quarters.

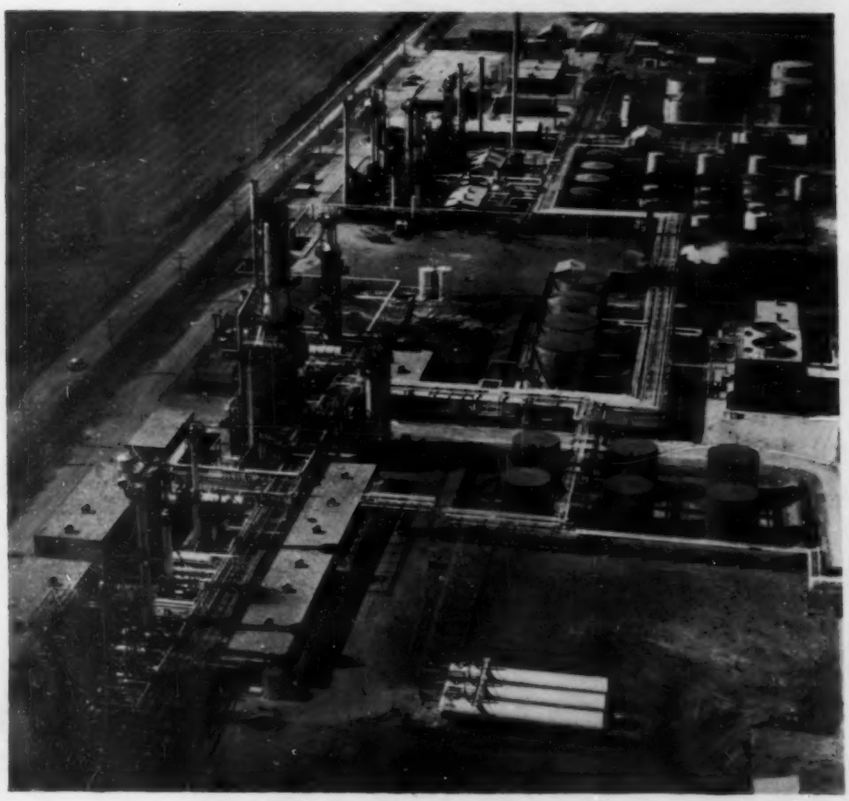
An important addition to refining facilities on the Prairies in 1955 was the completion of the first lube plant in that area.[1] Imperial Oil, Ltd. activated a unit at Edmonton, which employs mild hydrofining and other modern processing methods to produce enough standard grades of lubricants to meet demands of the general area.

Refining in Manitoba had an outstanding year with the capacity of the province being nearly doubled by the construction of a completely new refinery for North Star Oil, Ltd. The new 12,000 b/d refinery replaces an obsolete 4,000 b/d plant which has been dismantled and re-assembled in northern Alberta, where it is going into operation this Spring. The new plant went on stream in July, 1955.

The North Star refinery incorporates several unique features, even including the first use in Canada of exterior painting of all units in bright contrasting colors and the design of the control room with a full glass wall on the side opposite the panel, providing natural daylight of about the same light intensity of the outside.

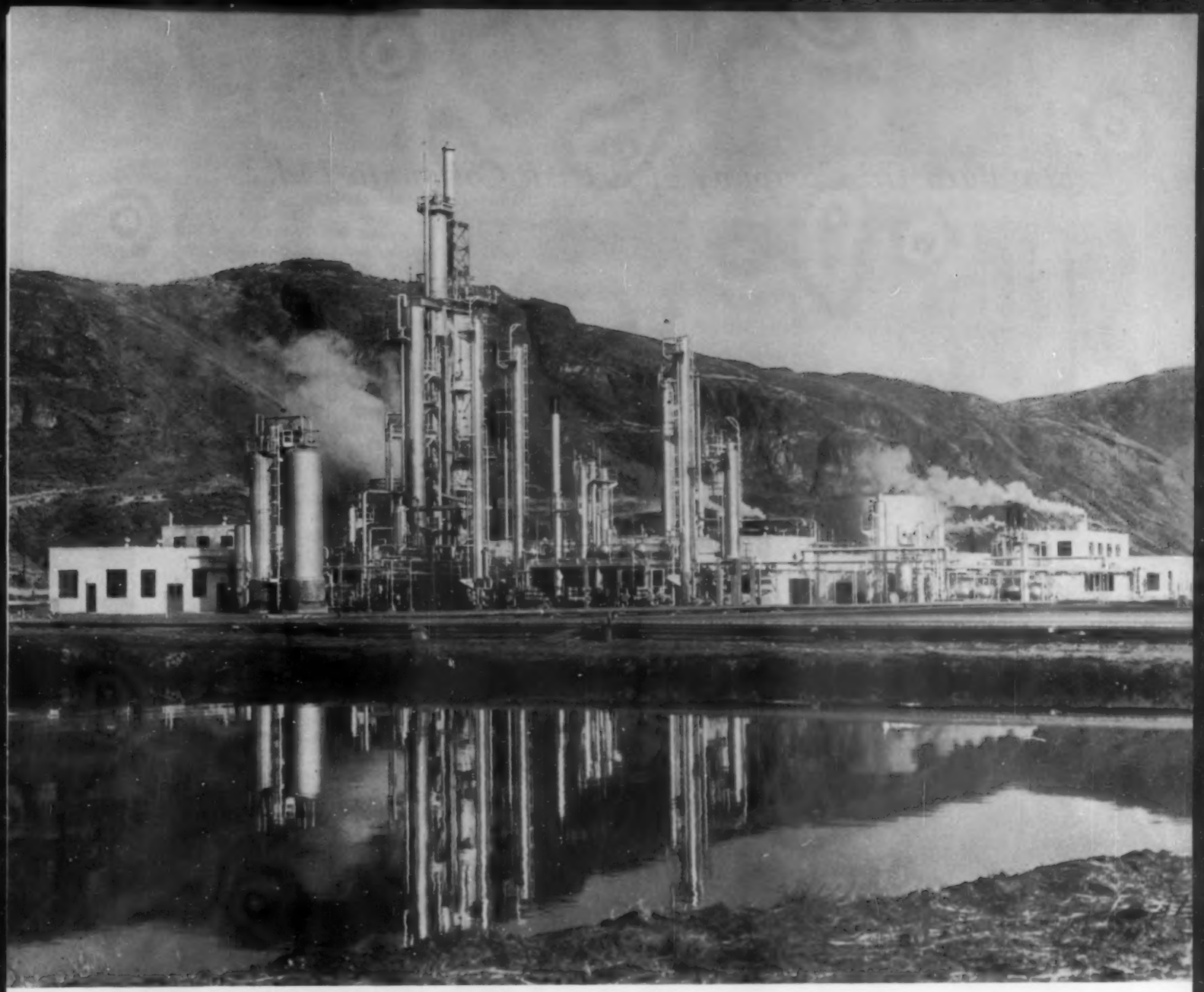
The refinery is designed specifically for a very high proportion of high octane gasoline in its runs. The process units are set up in a group which is entirely operated from the central control room and there is no need for intermediate storage in transfer between units. Transfer is completed in a hot state, for economy, minimizing the provision of heat transfer equipment. For full flexibility, however, it is possible to operate the cat cracker, gas recovery and polymerization sections independently of the topping, vacuum and treating sections, and it is also possible to shut down the vacuum unit but keep the other units on stream.

The Orthoflow Model "B" fluid cat cracker, of 5,000 b/d capacity, places the



General view of the 13,000 b/d Consumers' Co-operative Refineries Ltd. refinery at Regina, Saskatchewan.

[1] *World Petroleum*, February 1956, p. 44.



The 5,000 b/d modern refinery of Royalite Oil Co., Ltd. at Kamloops, B.C., consisting of a crude distillation unit, a UOP designed catalytic cracking and polymerization unit and a gas concentration unit. (Photo courtesy of Royalite Oil Co., Ltd.).

regenerator directly above the reactor and hence provides lower-pressure operation. Size of the vessels is reduced and power requirements are lower. A special feature new to Canada is that the top head of the reactor also functions as the bottom of the regenerator. This eliminates the need for expansion bellows on the standpipes and riser passing from one vessel to the other.

This refinery shares with the Imperial Oil Ltd. refinery, built in 1950-51, a cold weather construction feature of unhoused boilers and pumps. The same designer-contractor (The Canadian Kellogg Company, Ltd.) did both jobs and this economy feature had proved so successful in the Imperial refinery that it was incorporated in North Star.

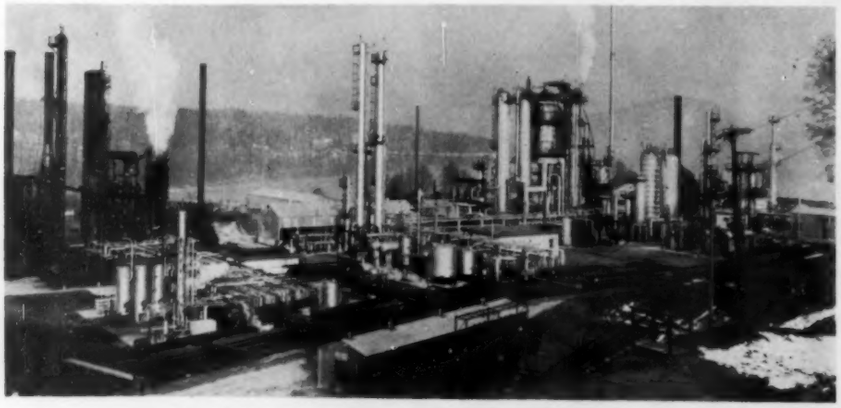
The record of five years' continuous operation of the Imperial refinery shows faultless operation of the pumps, which are all motor-driven centrifugals, resting on ordinary concrete slab foundations supported by spread-bore cedar piles because of shifting subsoil conditions in the Winnipeg area. No abnormal maintenance has been required and no additional depreciation has been incurred from exposure to the weather. The steam boilers have also been trouble-free in their five years outdoors, and the large capital saving effected by leaving them unhoused has not resulted in additional maintenance.

A maintenance innovation introduced in 1955 was the extension of the normal shutdown and turnaround period from 12 to 18 months, running from the spring of 1954 right through to last fall. This extension resulted in a substantial cash saving and an increase in running time and hence in gross throughput for the period. It is hoped that the interval between shut-down and turnaround periods can be extended to two full years on the next cycle, as the fall is a better seasonal occasion for this suspension than the spring.

Total refining capacity in Manitoba is now rated at 29,000 b/d, but in practice, according to maximum actual throughput figures, it would be theoretically possible to run at least 35,000 b/d concurrently. The Imperial refinery has run as much as 50% over its rated 12,000 b/d capacity at times.

The development of additional refining capacity last year rendered Manitoba more than self-sufficient for petroleum products and will be adequate for the expansion of demand at least until well on in 1957, so that no immediate plans are being made for further construction.

Standard Oil Company of British Columbia Ltd.



General view of Stanovan refinery of Standard Oil Company of British Columbia, Limited, located at North Burnaby, British Columbia.

Standard Oil Company of British Columbia Ltd. added considerably to its refinery at North Burnaby.

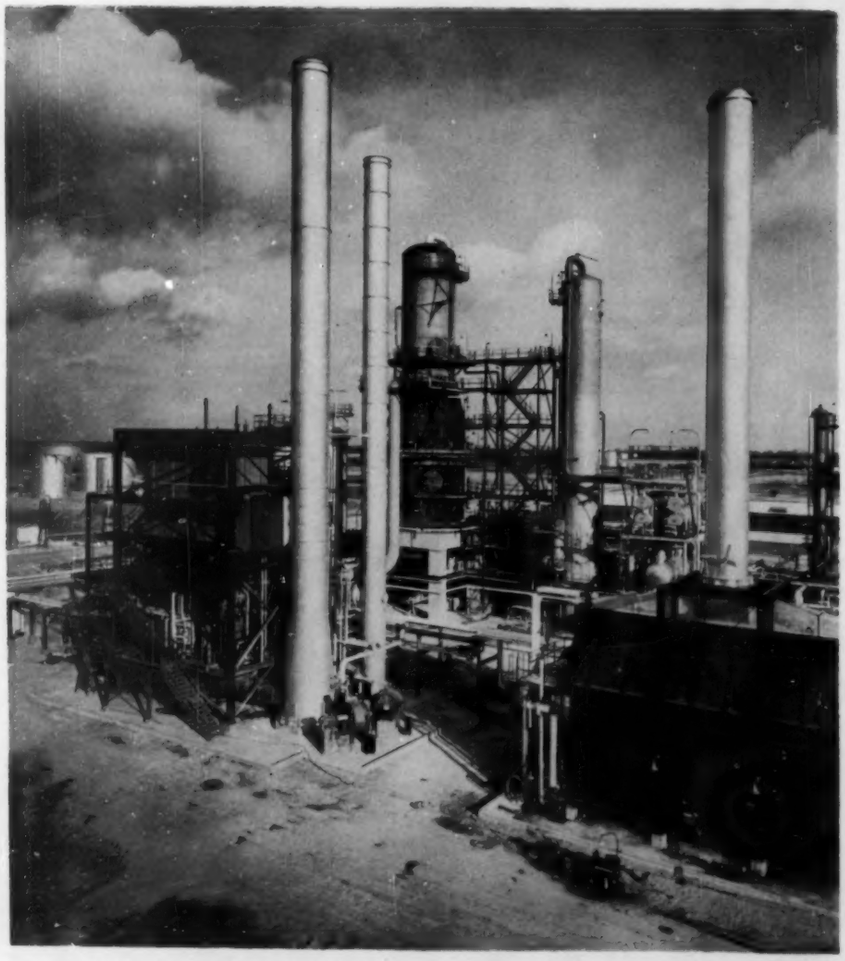
In 1955 a U.O.P. platformer unit with a capacity of 2,750 b/d of feed was built and placed in operation. The capacity of the crude unit was raised from 11,500 b/d to 16,000 b/d by the addition of another crude furnace and by a few other modifications.

New stove oil treating facilities with a capacity of 3,600 b/d of feed are planned for 1956.

Capacities as of January 1, 1956 are as follows:

Crude unit, 16,000 b/d feed; fluid cat. cracker, 9,000 b/d total feed and recycle; cat. polymerization unit, 1,200 b/d feed; U.O.P. platformer, 2,750 b/d feed.

Canadian Oil Companies Ltd.



Further reducing air pollution in Ontario's "Chemical Valley" at Sarnia, Ont. This carbon monoxide boiler, recently set into operation at the Sarnia refinery of Canadian Oil Companies, Ltd., is the first of its kind in Canada. Part of the expansion program underway at the refinery, this boiler cost nearly $500,000 to build. (Photo courtesy of Canadian Oil Companies, Ltd.)

Holding a distinctive place in Canada's enormously growing oil industry, because of its particularly Canadian aspects, after a year of record earnings and progress, Canadian Oil Companies, Ltd. is again expanding on all fronts.

Foreseeing a 10% increase in Canadian petroleum consumption during 1956, Canadian Oil is investing over $9 million on over-all expansion. Some $3 million is being allocated for exploration and development in Western Canada. Refining and marketing facilities are being expanded with total expenditures of some $6 million provided largely from the company's own operations.

Rated as the largest Canadian owned and operated oil company, its major development in 1955 was the purchase of a pioneer western producer . . . the Anglo-Canadian Oil Co., Ltd. By this one move, Canadian Oil became a fully-integrated oil company carrying on all essential operations from oil production in the field to marketing of refined products. Through this transaction, one of the most significant in its 50-year history, Canadian Oil acquired some 13 million barrels of oil reserves in Western Canada and one of the most experienced producing organizations in Canada.

Canadian Oil's offer to purchase Anglo-Canadian was accepted on the basis of one-seventh share of its own stock and $2.75 in cash for each share of Anglo-Canadian.

The producing wells and exploratory acreage involved in the merger, one million gross or 460,000 net acres, are largely in Alberta, but include also Saskatchewan, Manitoba and adjoining states of the U. S.

At its Sarnia refinery, approximately 7,360,000 barrels of Canadian crude oil was processed in 1955, an increase of 10%, with daily throughput at 25,000 in December.

The company has underway a $3 million expansion program to increase over-all capacity at the Sarnia refinery to 30,000 barrels daily. Present plans call for this to be essentially completed late this year.

First of its kind in Canada, a $500,000 carbon monoxide steam generator has been one of the major additions. This went on stream in November last, and has since been operating in excess of design loads. This boiler uses waste CO and sensible heat in the cat. cracker regenerator flue gas to generate 60,000 lb/hr of steam. Oil burners in the boiler supply heat for 40,000 lb/hr of steam to make the total capacity of the boiler 100,000 lb/hr.

The cat. cracker feed preheater was tied into the unit in October, 1955, and was started up without incident. It is operating continuously and studies are in progress to evaluate its effect on product yields.

Some smaller items have been added, such as pumps and exchangers, principally to the cat. cracker, so that other bottlenecks could be evaluated and feed rates increased.

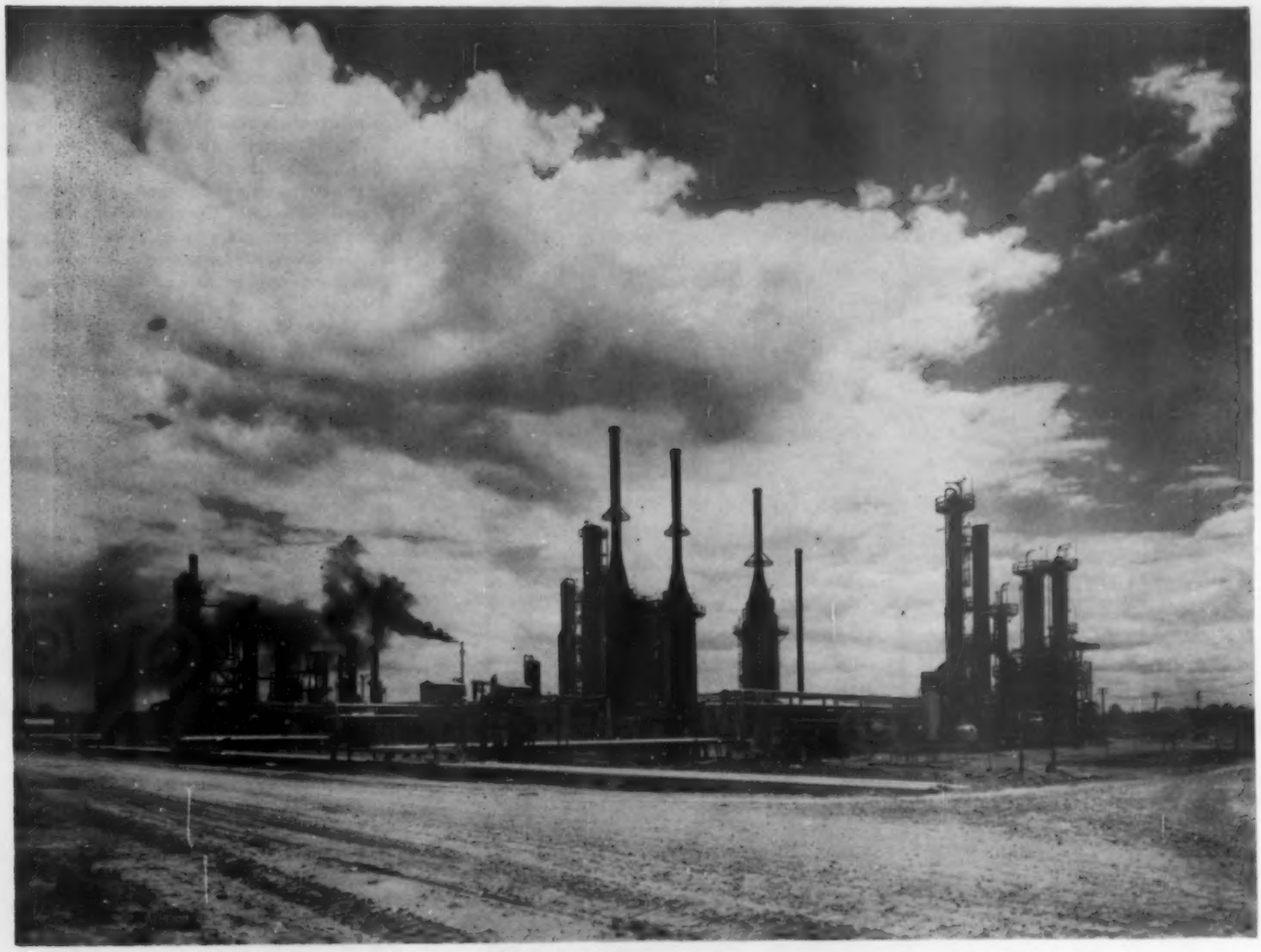
The remaining major equipment necessary for the projected crude increase will be added in May, 1956. At this time a new 60 million btu crude heater will be tied in and the cat. cracker gas compressor will be increased in capacity. In addition, the main crude unit towers will be equipped with high capacity trays, and modifications will be made to the bottom three plates of the cat. cracker fractionator. A number of heat exchangers and pumps will be installed . . . principally in the crude unit and extensive piping changes made.

A new administration and plant protection building is under construction and it is also planned in 1956 to expand the laboratory and quality control facilities.

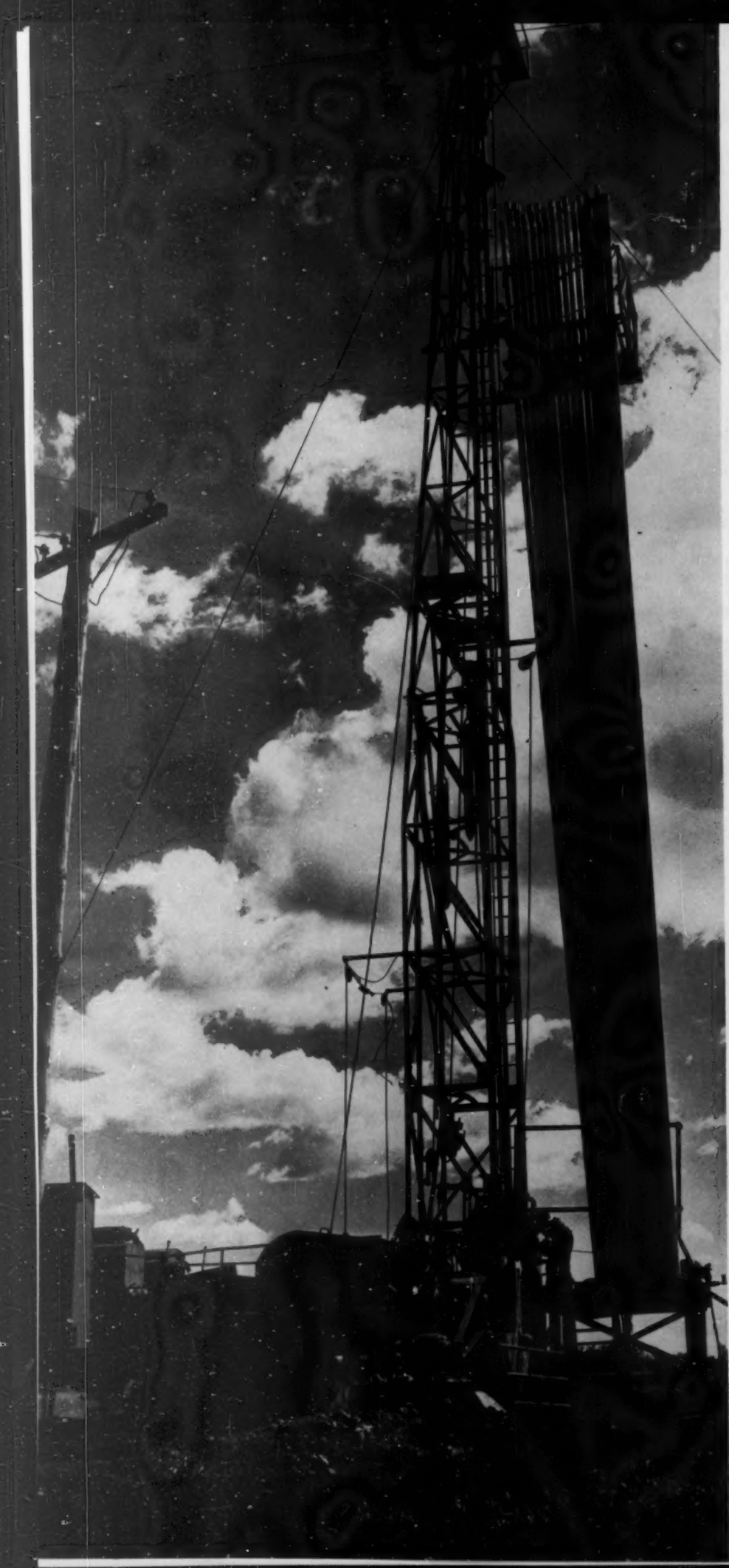
Another significant achievement in 1955 was the introduction of the company's new White Rose Ultra Gasoline—available in areas served by the company's refinery—the highest octane gasoline manufactured in Canada. The company also has introduced a new multi-grade motor oil blended at its Montreal plant. Some 200 White Rose service stations of new design were opened in 1955, making more than 3,000 retail outlets across Canada.

To balance the company's growth in other respects, market research activities have been centered in a special department; a large advertising program featuring White Rose products and the company's distinctive Canadian characteristics will be continued; along with the establishment of many more modern retail outlets of special design.

Some 20 miles southeast of Sarnia, at Oil Springs, Ontario, Canadian Oil has a development of historic interest. Very extensive research carried out by Col. R. B. Harkness, D.S.O., former Natural Gas Commissioner of Ontario, and Professor Tallman of the University of Western Ontario, has shown that North America's first successful oil well was brought into production in this area in 1857, with production averaging 60 barrels a day. Supported by other leading Canadian historical authorities, Colonel Harkness has been able to document this discovery site as the birthplace of North America's oil industry. The property, owned by Canadian Oil Companies, Ltd., is to be restored as a historic site. (*Continued on page* 118)



View of Canadian Oil Companies' refinery at Sarnia, Ontario. Shown are crude distillation unit (center) flanked by catalytic cracking unit (left) and catalytic refining unit (right). Its presently rated capacity of 25,000 b/d was increased from its initial capacity of 20,000 barrels. An expansion program now underway will further increase daily capacity to 30,000 b/d.



Alberta government photograph.

While majority and opposition party members of Parliament argue about Crown participation, Trans-Canada has been granted still another extension for financing the transcontinental gas line.

TRANS-CANADA

By W. L. Dack

FOR the fourth successive time the Trans-Canada Pipe Line Co. has been granted a six months time extension in which to arrange financing of the 2,240-mile, all-Canada gas pipe line.

The granting of the extension does not preclude the later Government decision to build the entire line itself, Justice Kearney of the Board of Transport Commissioners stated recently in presenting the Board's decision.

The whole Trans-Canada pipe line proposal is currently under heavy political pressure from opposition parties in the federal government. Debate has already been opened on the government's plan for aiding the long-stalled pipe line project—the proposal that a Crown company, jointly financed by the federal and Ontario governments, build the $118 million Manitoba-to-Ontario section of the line.

While the controversy rages in Parliament a new figure has entered the picture. Frank McMahon, head of the Westcoast Transmission group which now is building the big-inch line from Peace River to Vancouver and the United States border, has come up with a proposal for private building of the entire line. Mr. McMahon is said to have made tentative arrangements to sell Canadian gas to a group of U. S. companies who have been bitter opponents of the Tennessee Gas Transmission deal with Trans-Canada.

With a guaranteed outlet to U. S. companies in the middle west states Mr. McMahon is said to think that he can finance an all-Canada line north of the Great Lakes to Toronto and Montreal without any government aid except some relief on sales taxes and duties. The new plan would visualize the exportation of 700 mmcf/day of gas to

Though working in sub-zero temperatures, these crewmen, Wesley Colton, Lloyd Hatlelid and Ronald Dumont of Imperial Oil prefer fruit juices to hot drinks on the job. (Photo courtesy of Imperial Oil Limited.)

Roughneck Slim Owre, checks front-encrusted mechanism for operating the hydraulic control head while the mercury bottoms at 53 below. (Photo courtesy of Imperial Oil Limited.)

GAS LINE...a political football

the U. S. as compared with 500 mmcf/d under the present Trans-Canada plan. Both would require U. S. Federal Power Commission approval. However, Mr. McMahon is reportedly willing to go ahead without FPC approval if the Canadian government will agree.

If the Government can carry this proposal in the federal House hopes are high that Trans-Canada will be able to arrange financing for the remaining Alberta-to-Manitoba section of the line through private funds.

But the Crown company proposal has become one of the most controversial issues to hit the floor of the federal house in the last 12 years. Opposition parties are strongly advocating scrapping of present plans in favor of an entirely government-built and owned pipe-line project. Only in this way can an early line construction start, and Canadian ownership of this vital national link, be assured, they claim.

Liberal party Cabinet members, however, determined not to add this to the government's roster of public liabilities are striving to force the issue through by sheer weight of voting numbers. They see any government agency that must purchase gas from the producers in Western Canada and sell it to utilities across the country, placed in a most awkward position. The possible large-scale sale of Canadian gas to U. S. private interests could also provide a perennial source of political fire.

Since the liberal party commands a sizeable overall majority in the federal House and still gives evidence of voting as a unit on this thorny issue there is a good chance that the Crown company plan will carry.

But Trans-Canada officials—and the government authorities most closely connected with the pipeline policy—realize they are all very much "on the spot" on this issue and that mounting popular criticism demands some early action on this tough national problem.

Because of this, major efforts are being made to arrange private interim financing for the $80 million Alberta-to-Manitoba section of the line. Pipe supplies have already been contracted for and hopes are high that financing might be cleared up in time to permit close to a full construction season's work on this first major phase of the $375 million "big inch" line to eastern Canada. This would probably mean that the group of companies now sharing partnership in this, the longest gas pipeline project ever undertaken (Canadian Delhi and Western Pipe Lines, 24½% each; Tennessee Gas Transmission, Canadian Gulf Oil and Hudson's Bay Oil & Gas, 17% each) will have to advance a sizeable proportion of the risk capital themselves.

The major long-term sales contract by which Trans-Canada had planned to arrange institutional financing—export of 200 mmcf of gas daily to Tennessee Gas Transmission Corp. at Emerson, Man.—depends entirely on outcome of current hearings before the Federal Power Commission in Washington. But Tennessee Gas's application, seeking approval for this gas import to feed its vast new pipe line into the Mid-west, has run into heavy opposition from a group of U. S. Mid-west gas utility and pipe line companies, as well as from railway and coal interests. There is every indication that this will be a long drawn-out struggle with little expectation for a decision for another year, at least.

It is because of this stubborn F.P.C. hurdle—and the mounting clamor in this country for early action—that Trans-Canada officials are now endeavoring to work out some other financing arrangements that will permit a start on the western section of the line this summer. Although optimistic about eventual FPC approval to gas import into U. S., this nevertheless is still very much in the nature of a "risky" investment. The successful enactment of the Canadian government's Crown company plan to build the tough Manitoba-Ontario section, however, would place a firm foundation under the entire undertaking; would eventually assure the line standing on its own feet, regardless of U. S. markets.

At the present moment either one of these developments—Government approval of Crown company proposal, or Trans-Canada announcement that it had succeeded in securing sufficient interim financing to enable a pipe line construction start this year—would considerably improve the chances of the other. Construction of the Crown company section, as presently planned, is entirely dependent on Trans-Canada's ability to finance the Western section and would not start until the year following completion of the Alberta-to-Winnipeg section.

Construction of this Western step would involve a total investment in the Prairie Provinces of around $164 millions this year alone. This would be made up of some $92 millions to be spent by Trans-Canada and gas utilities in Saskatchewan and Manitoba for transmission and distribution lines; about $36 millions to be spent in Alberta for field gathering and trunk pipe lines; about $16 million for scrubbing and other gas processing facilities in Alberta and some $20 millions for extra gasfield development drilling in Alberta.

That's the Western pipeline picture. But there also could be a construction start this year on an important part of the Eastern section—the 340-mile, Toronto-to-Montreal section of the line.

In the application currently before FPC, Tennessee Gas Transmission (with its subsidiary Midwestern Natural Gas) is seeking approval of plans to both import Canadian gas into the U. S. Midwest and export U. S. gas into Ontario at a Niagara River crossing point. Trans-Canada would use the imported U. S. Gas for load build-up in the highly industrialized Ontario and Quebec markets. This U. S. gas would then be gradually replaced by Canadian gas once the Trans-Canada pipe line from Western Canada was completed. The application asks for permission to export close to 80 mmcf of gas daily.

So far there has not been any great opposition developed against this Ontario export part of the integrated Trans-Canada-Tennessee Gas pipe line plan; nothing like the opposition facing the bigger import proposal into the U. S. Midwest. Because of this Trans-Canada officials are hoping that this part of the overall application before FPC might be considered separately and a favorable decision secured this summer. If such was the case every effort would be made to extend the present Niagara-to-Toronto section of the Trans-Canada system on to Montreal this year.

In the meantime several gas distributing companies have been competing actively in Ontario for franchises to supply gas to Ontario municipalities within economic range of the Trans-Canada pipe line system. Although in the majority of cases it will be impossible to deliver gas until either U. S. gas imports are sanctioned by FPC or the Trans-Canada pipe line system is completed to Eastern Canada, the companies have moved rapidly to prepare for such developments.

In a fast-stepping campaign Northern Ontario Natural Gas Co. with a Canadian president and strong U. S. backing, has signed up some 20 by-law and franchise arrangements involving municipalities stretching from North Bay to Kapuskasing in northern Ontario; and further still, including municipalities like Kenora and Dryden. The Ontario Fuel Board has already approved most of the by-law and franchise arrangements and hearings for final granting of "Letters of Public Convenience and Necessity" to supply the towns with gas will be held April 10. At this time Northern Ontario Natural Gas officials must be able to satisfy the Fuel Board on their engineering and financing capabilities.

Northern looks on its particular market area as the stretch from Barrie—60 miles north of Toronto—up highways 11 and 17 as far as the Manitoba border. Although not heavily populated this area takes in a good slice of the potential mineral and forest wealth of Canada. It also comprises one of the highest fuel cost areas in the country. Close to one million tons of U. S. coal is imported into this territory every year.

Northern first estimated that this area would have a potential market of around 50 mmcf daily by the fifth year of pipe line operation. But this potential has now been upped to around 80 mmcf daily. Northern estimates cost of utility system to serve the largest possible number of customers in the area would absorb an overall capital outlay of around $52 million. Laterals to feed the various off-line markets would cost another $10.5 million.

Northern's whole program, of course, is entirely dependent on ability of Trans-Canada—along with federal and provincial aid—to clear up its major financing problems. Northern's officials look on plans for formation of a Crown company—financed 65% by federal, 35% by Ontario governments—to build the difficult Manitoba-Ontario stretch of the line, as a big step in guaranteeing eventual pipeline construction.

Although Northern is still a private firm backed mainly by U. S. interests, steps are already under way to make it a public company with finances to be arranged by a strong syndicate of investment houses both in U. S. and Canada. Here's a look at some of the key personnel:

R. K. Farris, Vancouver, president. Mr. Farris is a West Coast oil man and president of Charter Oil Co. which holds wide interests in producing, partly developed and undeveloped properties in B. C., Alberta and Saskatchewan. He is also a director of Cascade Natural Gas Corp., Washington.

Chester Gray, Toronto, vice president and general manager, has had wide experience in gas utility business both in operations and engineering fields. He was 17 years with Public Service Electric & Gas Co. in U. S. before coming to this country.

C. S. Spencer Clark, Seattle, Wash., and Calgary, Alta., director, has built up wide experience in gas utility business in northwest U. S. He is chairman of Cascade Natural Gas Corp., a company with wide utility interests in states of Washington, Idaho and Oregon.

Lakeland Natural Gas Co., formed in mid-1954, has been successful in signing up close to 20 municipal franchises in one of the richest parts of Ontario—the stretch from Port Hope to Cornwall, along the north short of Lake Ontario and the St. Lawrence River. The Ontario Fuel Board has already approved some 17 by-law and franchise arrangements and the hearing for granting of letters of Convenience and Necessity were held several weeks ago. Lakeland was able to present pretty convincing proof of its engineering and financing ability and the Fuel Board is expected to grant this final approval within a few days.

Lakeland's whole plan, of course, depends entirely on Trans-Canada's ability to secure sufficient gas supplies to enable construction of a line extension from Toronto eastwards to Montreal. This extension would closely follow the route of the present main (No. 2) highway and pass through —or close to—all the municipalities Lakeland plans to serve.

Lakeland sees initial capital outlay of some $12 million to design and build the municipal gas systems. Expenditures will expand considerably after that with new distribution lines, more municipal hookups. Initial market is estimated at around 25 mmcf daily. But growth potential is very great.

At the present time Lakeland is a privately owned company and plans are to put up all the initial expenditure itself. George Gardiner—young Toronto investment firm head—is Lakeland president. For vice-presidents he chose Welland D. Woodruff, Toronto broker and manufacturer's agent; L. Sanford Reis, senior partner in New York firm of Reis & Chandler (public utility consultants) and also head of Great Northern Gas Utilities, Edmonton).

United Suburban Gas Co., Hamilton, has been granted right to supply the towns of Acton, Milton and Georgetown, some 30-35 miles west of Toronto. There is a good chance these markets will be getting gas by the end of this year. United Suburban, a wholly-owned subsidiary of United Fuel Investments Ltd., Hamilton, completed a contract late this year with Niagara Gas Transmission Ltd. for a supply of gas to serve Oakville and Bronte and the southern part of Trafalgar township, some 20 miles west of Toronto. Niagara Gas Transmission Ltd., wholly-owned subsidiary of Consumers' Gas Co. of Toronto, is a pipe line company which has been transporting U. S. gas from a Niagara River point to parent company's gas system at Sheridan, on Western outskirts of Toronto, since Nov. 1954. Because of nature of long-term take-or-pay contract with U. S. suppliers Consumers' Gas will have sizeable surplus gas for sale in first three or four years of pipe line operation.

Consumers' Gas Co. of Toronto is seeking to widen scope of its marketing activities very considerably and is currently asking permission to serve Ajax and Woodbridge, also on Toronto borders. Company has also purchased the propane air plant and distribution facilities of Ontario Shore Gas Co. which serves Oshawa, Whitby and Bowmanville. Consumers' Gas plans to convert the propane air system and customer's appliances to natural gas by fall of this year, at its own expense. The natural gas will be supplied by a pipe line from Toronto to the Oshawa, Ajax, Whitby and Bowmanville area. Rates will be same as those charged in Metropolitan Toronto, Brampton and Streetsville.

A private bill has been introduced into the Quebec Legislature for incorporation of Quebec Natural Gas—a company which has arranged to purchase the present manufactured gas facilities in the Greater Montreal area. Trans-Canada has carried on extensive marketing negotiations with the newly formed board of Quebec Natural Gas. Any long-term contract, however, is again dependent on Trans-Canada's ability to secure gas to serve this, the biggest single market in Canada.

Canadian Oil Companies' new $300,000 administration and plant protection buildings at the Sarnia Refinery. (Architect's drawing)

Royalite Oil Company's new 6-story home office, 2nd Street West at 7th Avenue, Calgary, Alberta, is typical of metropolitan building expansion in that province. The foundation of the Royalite Building is designed to permit construction of an additional six floors at a later date. The present structure is now nearly completed and will cost in excess of $2.5 million.

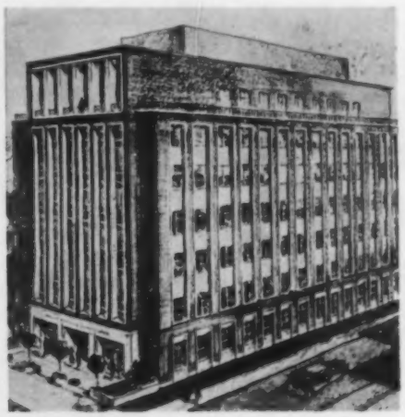
The building has a ground floor area of 15,000 square feet. Each of the additional floors have an area of 13,000 square feet, making a total of 65,000 square feet of office space. More than half of this space is now occupied by Royalite Oil Company, Limited, with the remainder made available for other firms.

new office buildings in CANADA

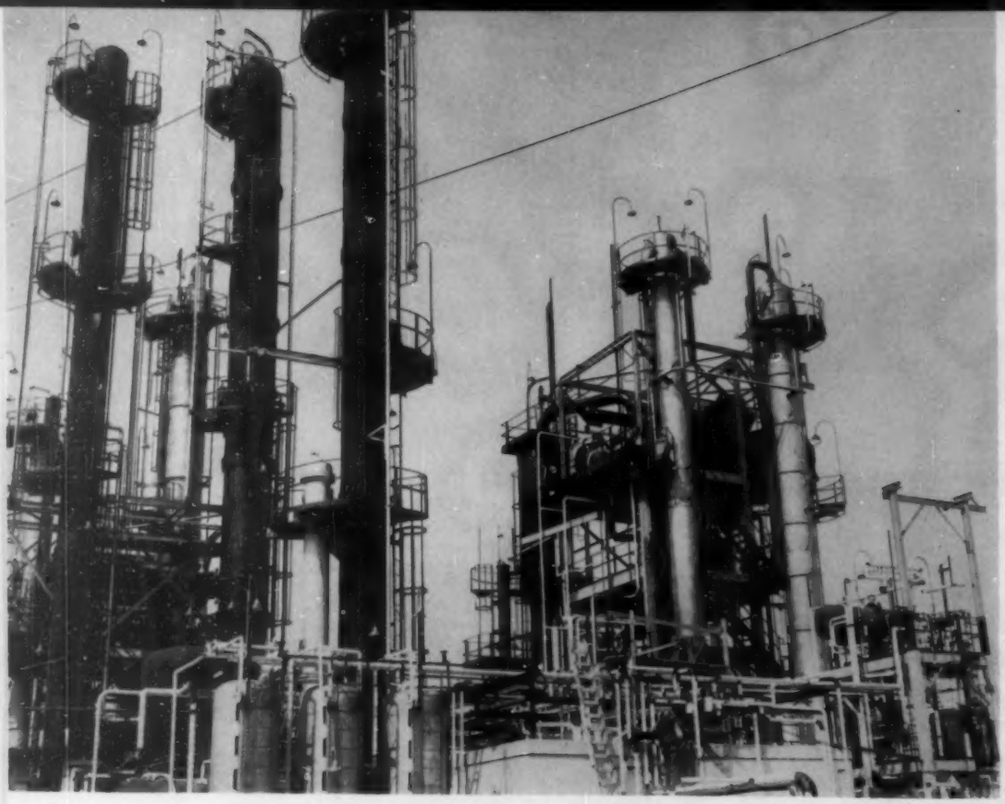
THE rapidly growing Canadian oil industry is bursting at the seams for office space. Most companies have added personnel to handle their growing business and are finding themselves short of places to put them in. As a consequence, most of the companies have had to seek more room, either in rented buildings or through their own construction. Many have chosen to build. Among the most interesting of the new buildings planned are those shown here.

Shell Oil Company is building a new 12-story office building in Toronto, with construction anticipated to start this year. Shown is the architect's preliminary conception of the building, which will be located on University Avenue immediately south of the present MacLean-Hunter Building. Cost of the Shell Oil Building is estimated at $4.5 million. It will be finished during late 1958. (Photo courtesy of Shell Oil)

A new office building to be erected in mid-town Toronto by Regent Refining (Canada) Ltd., starting early this summer. Costing approximately $2 million, it will have seven stories, five of which will be occupied by Regent executive and office staff, leaving the street level and one other floor available for renting. The building is expected to be completed in July 1957. It will be air-conditioned and contain a board room, library and dining rooms for staff.



Imperial Oil's new head-office building under construction on St. Clair Avenue, Toronto, is shown in this architect's drawing. The 19-story structure is expected to be completed early in 1957. With its top nearly 500 feet above sea level, the skyscraper will occupy a commanding position in the city's skyline. The buildings will be air-conditioned throughout, with acoustic ceilings and high-intensity fluorescent lighting in all offices. (Photo courtesy of Imperial Oil Limited)



General utility still and fractioning towers at BA-Shawinigan phenol-acetone plant in Montreal.

The Canadian petrochemical industry is experiencing its period of greatest growth in 1955. Construction now underway will increase capacity by about one-third.

Petrochemicals in Canada

CANADA'S investment in petrochemical manufacturing facilities has increased 15-fold since the close of World War II to $300 million. An additional $53.5 million in new plants is now in course of design or construction.

Most recent announcement has been that Imperial Oil Ltd. will spend $38 million to build a detergent alkylate plant at its Sarnia, Ont., refinery. Imperial organized its chemical products department late in 1955 and the Sarnia project is the first announced by the company. Heretofore Imperial has devoted all of its energies to producing, refining and marketing conventional petroleum products.

When the plant is completed around mid-1957 its output will displace an annual import of about $2,500,000 worth of detergent alkylate and will make the Dominion self-sufficient in this product. It is anticipated that more than 80% of the new plant's output in the chemical will end up in Canadian homes as a cleaning agent in a familiar household detergent. Alkylate is also used in industrial synthetic detergents. Using gases produced in refinery operations, the plant will have a rated capacity of 30 million pounds yearly of detergent alkylate (dodecyl benzene) and smaller quantities of other alkyl aromatic compounds. Tripropylene and tetrapropylene will also be procuced in a section of the plant.

Shell Oil Co. of Canada is taking its third step into the fast moving petrochemical field. Additional plant facilities will be constructed at Montreal East to manufacture methyl ethyl ketone and secondary butyl alcohol.

The new plant facilities will be adequate to supply Canada's entire requirements of these two products which are currently all imported. The two chemicals are widely used in the paint, plastics and other industries.

"The new facilities are designed in such a way to enable us to conveniently branch out into the manufacture of still other petrochemicals at Montreal East," W. M. V. Ash, president, stated.

Construction work will start immediately. Raw material for the new unit, butylene, will come from Shell's Montreal East oil refinery. Shell's original chemical plant, opened in 1953, was first in Canada to produce isopropyl alcohol and acetone from petroleum. The company also produces elemental sulfur from sour gases at Jumping Pound, Alta.

Canada's petrochemical manufacturing operations now are centered at Montreal and Sarnia adjacent to the country's largest refining centers and on the Prairies, where vast volumes of natural gas is available as raw material. Natural gas reserves in the west are estimated at 19 trillion cubic feet. Much of the gas is sour, providing an abundant source of sulfur.

Montreal first became a petrochemical manufacturing center less than five years ago. Prior to that time most of the activity was centered at Sarnia. Several plants were built simultaneously at Montreal.

British American Oil Co. and Shawinigan Chemicals Ltd. joined forces to organize B.A.-Shawinigan and erect the first commercial plant to produce phenol and acetone from cumene.[1] British American manufactures 210,000 barrels per year of cumene at Montreal by the alkylation of benzene with propylene. Benzene is supplied by Shawinigan. The cumene is oxidized to phenol and acetone in a $4 million plant. Capacity is 13 million pounds of phenol and 8 million pounds of acetone per year.

Phenols from the plant are largely used in Canada for the production of synthetic resins. A smaller use is as a solvent in lube plants. The acetone is used by the paint industry as a solvent and is a component of rayon.

Shell Oil Co. of Canada is another producer of acetone at Montreal. Shell built a $4.8 million plant in 1953 to produce isopropyl alcohol and acetone. Capacity is 12 million pounds per year of alcohol and 8 million ponds of acetone. Propylene from refinery cracking still gases are used to produce the alcohol which is subsequently dehydrogenated to acetone. As mentioned above, Shell now is planning to expand its chemical operations to produce MEK and secondary butyl alcohol.

[1] *World Petroleum*, May 1953, p. 158 and May 1955, p. 88.

Union Carbide of Canada has purchased a petrochemical plant built at Montreal East in 1953 to process gases from the adjacent refinery of McColl Frontenac Oil Co. The plant originally was built at a cost of $12.5 million by Dominion Tar and Chemical Co. Several millions now are being spent by the new owners to change and enlarge it.

The chlorohydrin process was originally used at this plant to produce ethylene oxide, ethylene glycol, propylene oxide, propylene glycol, ethylene dichloride and other chlorinated products. Capacity of the plant was about 30 million pounds of finished products per year.

Since purchasing the Dominion Tar plant, Union Carbide has been converting it to use Union's direct oxidation process to eliminate the chlorine requirement. The plant will be expanded to produce polyethylene and other petrochemicals.

St. Maurice Chemicals is manufacturing formaldehyde and pentaerythritol at Varennes, Quebec. Synthetic methanol from refinery sources makes up part of the raw material.

There is no production of ammonia in Quebec at present, the six plants now building or operating. All are located in Ontario or the west. Quebec ammonia has been organized to build a 125 tons per day plant at Montreal.

Sarnia was the first area in Canada to develop a petrochemical industry. This was largely a government project at first to manufacture synthetic rubber for the war effort. Polymer Corp. now turns out about 93,000 tons of rubber per year. Capacity was stepped up 7,000 tons in 1955.

On an adjacent site, Dow Chemical Co. has developed a highly diversified plant producing ammonia, polystyrene and other chemicals. The ammonia plant has recently been enlarged to 100 t/d. Dow produces styrene, glycols, carbon tetrachloride, trichloroethylene and perchloroethylene among other chemicals. Gases from the Canadian Oil Companies refinery are cracked to produce 50 t/d of ethylene.

Cabot Carbon Co. has $3.4 million plant at Sarnia to produce 17,500 tons per year of furnace blacks from petroleum.

Total investments in petrochemical plants at Sarnia will be well over $150 million when Imperial's new detergent plant is complete.

Canadian Industries 1954 Ltd. is building a $9 million ammonia plant at Millhaven, Ont. Capacity will be 200 t/d. Fuel oil will be used as raw material.

Sulfur is one of the important products from natural gas in the west. Shell Oil Co. built a 10,000 ton/year plant at Jumping Pound in 1952. This since has been enlarged to 21,000 tons/year. Royalite Oil Co. has a 10,000-ton plant in Turner Valley, Gulf.

Canadian Gulf Oil Co. has begun construction of a 225 t/d sulfur plant at its Pincher Creek field, approximately 50 miles southwest of Lethbridge. Northwest Nitro-Chemicals, Ltd., will take a substantial part of the plant's output in liquid form.

The new Canadian Gulf installation will produce 1,900 barrels of condensate per day from 55 million cubic feet of natural gas in addition to the sulfur. The gas will be returned to the reservoir pending completion of the Trans-Canada pipe line which will provide a market for the natural gas.

Parsons Engineering is building the sulfur plant and the carbon treating and cycling plant and necessary appurtenances was contracted to Stearns-Rogers Engineering Co. Stearns-Rogers has begun the grading and surveying of the plant site. Completion is planned for October 1.

The plant has been designed to allow for increased capacity when the Pincher Creek gas is required for the Trans-Canada Pipe Line project. The ultimate plant is expected to produce approximately 8,000 b/d of condensate, 800 long tons per day of sulfur and in addition, will produce propane, butane and natural gasoline and provide 170 mmcf per day of residue gas for Trans-Canada Pipe Lines Ltd.

The Stage I plant will obtain gas from two Pincher Creek wells and inject the residue gas into a third well. It is expected that the two producing wells will supply 60 mmcf per day of raw gas and the injection well will receive 43 mmcf of residue gas per day.

The gas gathering system in the Pincher Creek field will be automatically controlled by the operators at the plant by means of a telemetering system. This allows the plant operators to gauge the flow of gas from the wells, make field temperature and pressure readings and open or shut in the wells as required.

Westcoast Transmission Co. will build a sulfur plant as a part of its project to deliver Peace River natural gas to the Pacific Northwest. Capacity of this plant has not been announced.

Largest petrochemical plant in the west is that built at Edmonton in 1953 by Canadian Chemicals Co. This $70 million plant produces a variety of chemicals, the most important being 25 million pounds per year of cellulose acetate and 17 million pounds of pentaerythritol. Other products include acetone, various alcohols, glycols, formaldehyde, acetic acid and acetaldehyde.

Ammonia is being produced in Western Canada by Consolidated Mining and Smelting Co. with a plant producing 260 t/d of ammonia and 200 t/d of ammonium nitrate. Sherritt-Cordon mines is to erect a $5 million plant to produce 75 t/d of anhydrous ammonia, at Fort Saskatchewan, Alta. The plant will produce ammonium sulfate and some ammonia for agricultural uses as well as for its own internal operations.

Canadian Industries 1954 Ltd. has erected a $15 million polyethylene plant at Edmonton. Capacity is 25 million pounds per year of resin. The plant now has some surplus capacity.

With construction now under way or planned, Canada is assured of an active year in petrochemical plant construction this year and in 1957.

The Turner Valley sulfur plant of Royalite Oil Co. Ltd. showing the sulfur stockpile in the foreground.

An aerial view of the Canadian Industries (1954) Ltd. Edmonton polythene plant. Using ethane-rich natural gas from the nearby Leduc-Woodbend field, the plant has been in operation since late 1953. Designed capacity is 24 million pounds per year, equal to Canada's estimated needs by 1957.

WEST COAST GAS LINE CONSTRUCTION BEGUN

By Don Tyrell

Through the courtesy of the Financial Post, Toronto, Canada

FROM the fertile rolling hills of the Fraser Valley farming country to British Columbia's rugged northland, railways, bulldozers, diesel trucks and hundreds of men and machines are working on the biggest single construction project in the history of the province. After years of wrangling, work is now well under way on the Westcoast Transmission Company's 650-mile natural gas pipe line which will feed gas from the Peace River areas of British Columbia and Alberta to Vancouver and cities in the northwest United States. Gas deliveries are scheduled for November 1957.

Actual pipe-laying on the Westcoast line started in the fall of 1955 when the first pipe was delivered to Huntington on the British Columbia side of the border for a start on the southern end of the line.

Work on the southern portion is expected to be completed this fall and, through agreement with Pacific Northwest Pipeline Corp., natural gas from that company's San Juan Basin fields in New Mexico will be fed into the Canadian line at the border pending completion of the Westcoast route from the Peace River area.

When the $152 million line from Fort St. John to the Pacific Coast is completed, Westcoast will supply Pacific Northwest with 300 million cubic feet of gas per day at the international border at Sumas. Pacific Northwest has signed an agreement with El Paso Natural Gas Co. for the sale of gas to El Paso.

Since early February shiploads of 30-inch pipe have been arriving in the port of Vancouver at the rate of 6,000 tons daily from mills of the South Durham Steel and Iron Mills at Stockton-on-Tees, England. Westcoast placed an order for 90,000 tons of main line pipe with the Durham firm for a price of $15 million, the largest purchase of its kind ever made in the United Kingdom by a Canadian firm.

This is about one-third of the main line pipe needed. As fast as the pipe was unloaded it was barged to the southern terminus of the Pacific Great Eastern Railway at Squamish for shipment to the Peace River area for use on the northern third of the line.

From Squamish, the pipe was carried 395 miles by special trains to Prince George and then trucked by Northern Freightways on the 225-mile last lap of stockpiling points. To handle the pipe, the railway, which will earn $2 million in freight on the pipe alone, ordered 40 extra flat cars and three 120-car barges.

Actual construction along the major parts of the route started in January. Crews from the Fraser Valley, the central interior and Dawson Creek moved into their locations and set up machinery for clearing the 60-foot right-of-way. Slash was burned and preparation began for river crossings. No merchantable timber was destroyed and registered firms of timber cruisers evaluated all the timber along the right-of-way with disposition of wood being made by arrangements with owners.

Route of the 650-mile main line with its 224 miles of gathering lines was determined by Canadian Bechtel Ltd. which designed the system and aided in development work. As builders and agents for the owners of the Trans Mountain Oil Pipe Line, the Bechtel men are familiar with the country crossed by the Westcoast line which in many cases runs close to the oil carrier. Canadian Bechtel will manage the engineering and construction of the line and build a portion of it.

Dutton-Williams Brothers Ltd., with headquarters in Dawson Creek is building the first section of the northern end. Bechtel's pipe line construction division has opened headquarters in Quesnel for operations on the second section. Contract for clearing the right-of-way in the Quesnel area has been let by Bechtel to Sovereign Construction and Engineering Ltd.

In Kamloops, Conyes Construction has a project office handling detail in that area and a gang clearing near Merritt. Several miles of pipe were laid last fall by Mannix Ltd. with headquarters in Chilliwack. This spring river crossings were cleared and prepared around Hope. With the arrival of warmer weather and better working conditions 2,000 men will be working.

Operators of the big inch gas line will be Westcoast and its wholly-owned subsidiary, Westcoast (Alberta) Ltd. While the line has been designed to supply an initial capacity of 370 million cubic feet per day with four compressor stations, provision has been made to boost capacity to an eventual 666 million cubic feet per day with eight compressor stations. Westcoast holds contracts for the sale of gas to two British Columbia utilities, Inland Natural Gas and British Columbia Electric Co. which presently supplies manufactured gas to the lower mainland of British Columbia.

The British Columbia Electric which is planning to spend more than $9 million on new lines and conversion of appliances has announced plans for a gas fired power plant. This plant, which will be used to boost the output of the company's electric power, will be built in the Vancouver area and will cost $7 million.

First compressor on the Westcoast line will be near Taylor on the Alaska Highway. The line will parallel the all-weather John Hart Highway through Pine Pass in the Rocky Mountains, continue south through the Fraser River valley via Prince George, Quesnel, Williams Lake and 100-mile House. From there it will go cross country to Savona and Merritt through Cold Water Canyon and Boston Bar Pass of the Cascade Range then via Hope to the Canadian-United States border near Sumas, Washington.

The route presents no more than the usual difficulty found in pipe line construction. Highways and railroads service most of the route which is considered good pipe-laying country.

Four firms are doing the actual building, with contracts still to be let for gathering systems, river crossing and compressor stations. In sequence from north to south,

the builders are: Dutton-Williams Brothers Ltd., 120 miles; Canadian Bechtel Ltd., 210 miles; Conyes Construction Ltd. 210 miles and Mannix Ltd. 110 miles.

Directing the overall work of Bechtel is Vice President S. D. Bechtel Jr. Associated with him are George S. Colley, Jr. vice chairman, President S. M. Blair, and Vice President Ray L. Hamilton who is responsible for engineering and overall planning. Vice President Harry F. Waste is project manager, Edward J. Mahoney, vice president and R. L. Bowman, pipe line division manager of construction will supervise work on Bechtel's 210-mile section of the line.

Coming of the natural gas pipe line to British Columbia climaxes more than 20 years of work and planning by Frank M. McMahon, chairman of Pacific Petroleums, parent company of Westcoast. Mr. McMahon conceived the idea of a pipe line to tap the gas fields of British Columbia's Peace River country in 1935. In four years after a start had been made in drilling, Pacific Petroleums and its associates drilled more than 100 wells. First drilling permits in the Peace River area were taken out by Pacific. Since the drilling of that first well more than $45 million has been spent.

Westcoast was incorporated in 1949 and in February 1952 after three years of hearings in Alberta, was granted the right to export northern Alberta gas. The Board of Transport Commissioners in Ottawa granted permission a short time later to export Canadian gas to the United States.

Hearings before the Federal Power Commission in Washington opened in June 1952 seeking permission to move Canadian gas into the United States. These hearings broke all duration records and ended in June 1954 when Westcoast's plea was refused. In December, 1954 Westcoast signed an agreement with Pacific Northwest Pipe Line Corp., the firm that won FPC aproval to supply Washington and Oregon with gas.

Pipe for Westcoast's natural gas pipe line is trucked away from the Pacific Great Eastern rail terminus at Prince George.

Pacific Northwest signed an agreement with El Paso Natural Gas whereby El Paso will purchase gas from Pacific Northwest which, in turn, will buy the gas from Westcoast. These were the agreements that gave the final go-ahead signal for construction of the Westcoast line, as without the additional Washington and Oregon markets the line would not be practical. British Columbia alone could not use the volume needed to justify building the line.

In the meantime, work is going ahead as fast as weather will permit in the northern sections and good progress is being made on the southern sections. Both Canadian Bechtel and Ford, Bacon and Davis, Inc., engineers for Westcoast, now have fully-staffed offices in Vancouver.

British Columbia Electric, which will supply the natural gas to the City of Vancouver, City of New Westminster, city and district of North Vancouver, District of Burnaby, Township of Richmond, City of Port Mood, University Endowment Lands, City of Port Coquitlam, District of Fraser Mills and Annacis Island, has already ordered more than $4 million worth of pipe in varying sizes from 22 inches down to small distribution sizes. To date the company has ordered 12,000 tons of pipe from Page Hersey Pipe Co. in Ontario.

Mannix Ltd. has been awarded the contract to build the British Columbia Electric line from Huntington on the B.C.-Washington border to Vancouver.

The 30-inch line now under construction is the first of two such lines planned by Westcoast who believe the second line will be needed by 1958 or 1960. The second line would follow the same general route as the one now being built until reaching Merritt. From there it will swing south through the Okanagan Valley where it will serve the prosperous small towns en route to the United States border at Osoyoos.

First shipment of pipe for Westcoast's natural gas line arrived in Vancouver, B.C., early in February from South Durham, England.

PHENOL REMOVAL SYSTEM OPERATES AT LOW COST

World's first biological system for phenol removal from oil refinery process waters at Sun Oil Company's Sarnia refinery completes two years of low-cost operation.

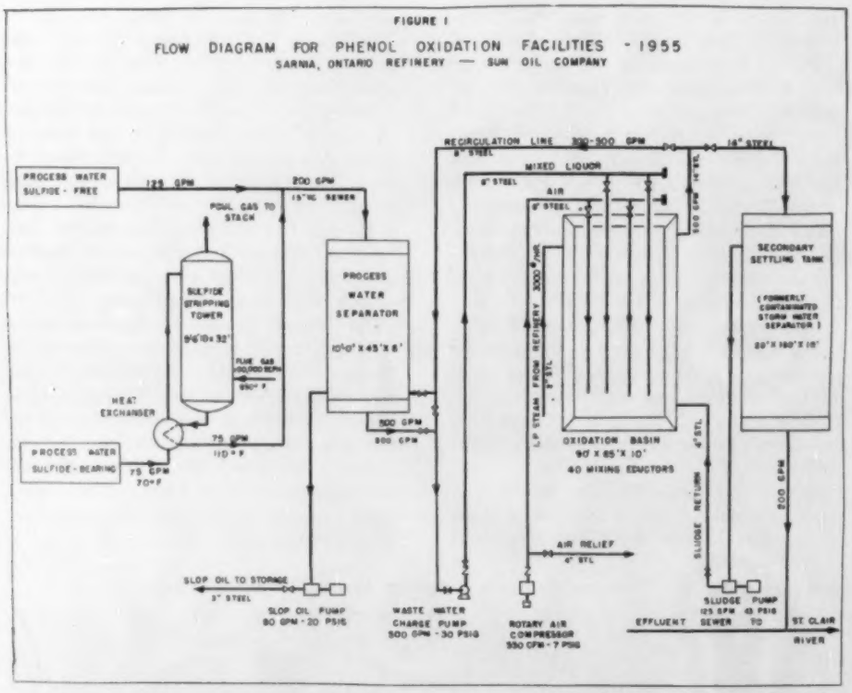


FIG. 1. *Flow diagram for phenol oxidation facilities of Sun Oil Company's Sarnia, Canada, refinery.*

TWO YEARS ago Sun Oil Company Ltd., installed the first waste disposal system in an oil refinery to employ bacteria for the oxidation of phenols. The elaborate system designed by Sun to minimize stream pollution was described by John L. Cushnie in the 1954 Canadian Review number of WORLD PETROLEUM (May 1954, p. 94).

Since that time the original system has been modified by the installation of an H_2S removal system when it was discovered that bacteria will feed preferentially on sulfides with the result that phenol oxidation is retarded and, in fact, the bacteria are harmed by the H_2S. They like it better, but it seems to cause indigestion.

As modified, the system eliminates all sulfides and 96.5% of the phenols from the process waters. Average phenol content in effluent is only 4.5 pounds per day from the 15,000 b/cd plant with its 11,000 b/cd Houdriflow catalytic cracking unit and 3,000 b/cd reformer. Cost of phenol removal is currently 45 cents per pound.

As pointed out by Mr. Cushnie in the earlier article, Sun installed three separate sewer systems with API separators at Sarnia. One handles process water, another contaminated storm water and the third cooling water. A fourth system handles storm waters from plant areas where there are no storage tanks or processing facilities.

Contaminated storm water is passed through two API separators equipped with mechanical equipment for oil and sludge removal. Bilge water from lake tankers is accumulated in two 10,000-barrel tanks for subsequent processing in either of the contaminated water separators. Although cooling water normally makes no direct contact with oil, is passed through two separators.

Initial operation of the biological oxidation in the treatment of process water at Sarnia began in November, 1953. Segregation of phenolic waters by process sewer and separator systems already installed assisted greatly in the construction of the new $40,000 bio-system.

Aeration pattern on the surface of biological oxidation basin is produced by air released at the bottom of the basin through 40 mixing eductors.

TABLE 1

ACTIVATED SLUDGE PLANT OPERATION DATA—SUMMARY*
SARNIA REFINERY—SUN OIL COMPANY

	PLANT INFLUENT			PLANT EFFLUENT			PER CENT REMOVAL
	Max.	Min.	Avg.	Max.	Min.	Avg.	Avg.
FLOW-GPM	250	150	200	250	150	200	—
pH	9.2	8.2	8.7	8.1	6.7	7.5	—
SULFIDES-ppm	65	2	18	0	0	0	—
SULFIDES-lbs./day	156	5	43	0	0	0	100%
PHENOLS-ppm	98	25	54	4.5	0.4	1.9	—
PHENOLS-lbs./day	235	60	130	11	1	4.5	96.5

*Data based on January-February, 1956, operation.

Oil and solids which can be separated are removed by a standard API process separator before passing the phenolic waste waters to the oxidation basin. Measuring 90 feet long by 65 feet wide and 10 feet deep, the bottom half of the basin's side walls was constructed with a two-inch layer of cement grout to reduce erosion.

Fresh feed water and recycle are introduced to this basin at the bottom. The total volume of water entering in this manner is 500 GPM and all is thoroughly mixed by air from a blower supplied to 40 mixing eductors.

A large concrete API gravity separator receives the overflow from the basin and serves as a secondary settling tank for bacterial sludge. The major phenol oxidation facilities with supporting numbers for rates of flow and dimensions are indicated on the flow diagram on *Figure 1.*

From the gravity separator, settled bacterial floc is pumped back to the oxidation basin while the clarified effluent is sent to the St. Clair River via the main refinery discharge sewer. Although not of convention design for bacterial floc recovery, this settling tank has not appreciably affected oxidation efficiency.

A hydrogen sulfide stripping tower was built in 1955 to remove objectionable sulfides and mercaptans and to raise the feed water temperature entering the oxidation basin. Using up to 100,000 SCFH of 950° F. flue gas from the regenerator section of the 11,000 b/cd Houdriflow catalytic cracking unit, the tower effectively removes more than 95% of the sulfides from over 100,000 gallons of water a day.

In operation, process waste water is piped to the top of the stripping tower and discharged through six cone-shaped nozzles, which divert the stream into a shower or curtain. This is met by a counter-current flow of flue gas from the bottom of the tower. After scrubbing, the water goes to the biological oxidation pit for phenol removal and final treatment. Hydrogen sulfide, picked up by the flue gas, is carried to a 280-foot vent stack located next to the Houdriflow unit.

Aside from the advantages of phenol removal from process water and lengthening of biological life due to the reduction of H_2S, the $60,000 stripping tower has also significantly reduced the amount of steam used by the refinery. Water, heated by the flue gas, has effectively increased the process temperature of the biological oxidation basin and thereby conserved steam formerly used for this purpose.

Operating data for the first two years of operation (prior to the installation of the hydrogen sulfide stripping) show that an average of 130 pounds of phenol in the process waste water can be oxidized a day. No loss in efficiency has been noticed even at a level of 200 pounds a day. Data based on January-February, 1956, operation indicates that the average phenol removal is 96.5% with the H_2S stripper included in the sludge plant statistics. A complete summary of this is given in *Table 1.*

Experience in the operation of the biological oxidation system prior to construction of the H_2S stripping tower indicates that high chemical oxygen demand caused by excessive sulfides is toxic to the bacterial colony. Although the process should have a temperature range of 70° to 85° F., it will operate with reduced efficiency, at a temperature as low as 60° F.

It has been found that other conditions necessary for satisfactory operation include: bacterial sludge volume index of four to six percent, a pH range of 6.0 to 9.0, dissolved and emulsified oil concentrations no higher than 150 ppm, phenol concentrations no higher than 200 ppm, and sulfide concentration no higher than 50 ppm. Higher concentrations can seriously injure the bacteria. Although apparently not toxic to the bacteria, a high oil content that will be absorbed on the biological floc and float the mixture to the surface thereby reducing the efficiency of the basin by removing some of the organisms from the process.

Since the original start-up after a regular maintenance shutdown of the refinery, re-seeding of the bacterial colony has been necessary only once.

Figures for 1955 indicate that phenol was removed at a cost of $0.45 per pound by the biological oxidation method. Total cost for operation, maintenance, electric power and steam, as indicated in *Table 2,* was $19,000.

TABLE 2

ANNUAL COST OF PHENOL REMOVAL—1955
BIOLOGICAL OXIDATION—SARNIA REFINERY,
SUN OIL COMPANY

Operation	$ 3,000	
Maintenance	5,900	
Electric Power	4,200	
Steam	6,000	
Total Annual Cost	$19,000	
Cost Per Pound Phenol Removed		$0.45
Initial Capital Investment		$40,000

Waste treatment area at the Sarnia refinery showing sludge pits and biological oxidation pit in the center, to left of two bilge water tanks. API separators are located behind main electrical substation. (All photos used in this article courtesy of Sun Oil Co.)

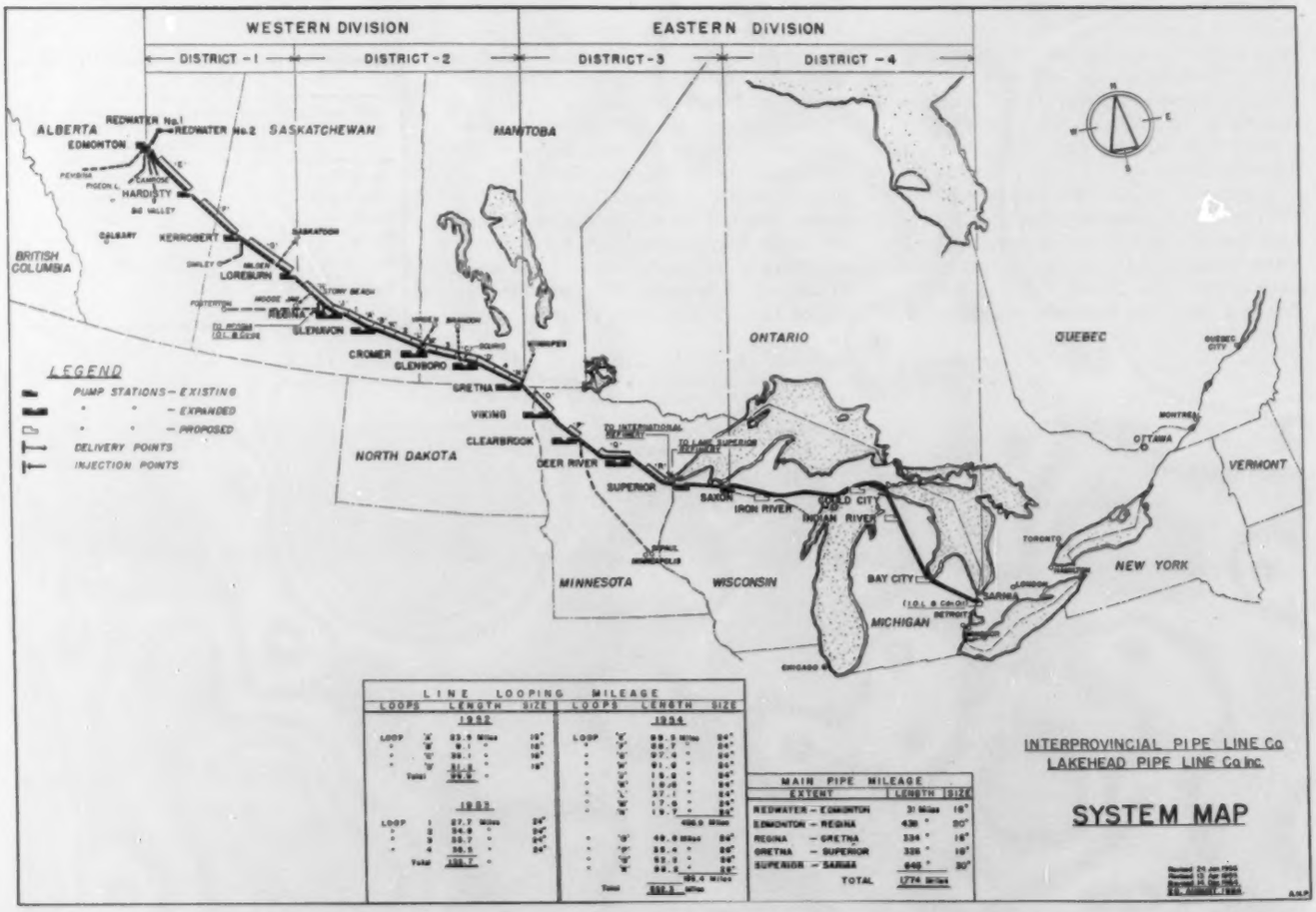
Oil pipe line mileage in Canada has expanded tenfold since Leduc. A decade of rapid expansion is in prospect in which $2,250 million in new pipe line investment may be required.

CANADIAN PIPE LINES

CANADA'S pipe line industry will invest $160 million this year in new facilities for the transportation of crude oil, natural gas and finished products. Pipe line construction will be more active than in any previous year in the history of the Dominion even including 1953 when Interprovincial Pipe Line Co. alone spent $81 million in developing its system from the Prairies to the Great Lakes. The 1956 total investment will be about double that devoted to pipe line construction in 1955.

Pipe line mileage in Canada has been increasing at an explosive rate since the boom began in the west. At the end of 1948 pipe line mileage totaled only 455 miles and two years later it was three times as great. The record since 1950 follows:

Year	Pipe Line Mileage at end of year
1950	1,423
1951	1,577
1952	2,500
1953	3,794
1954	4,685
1955	5,100-Estimate



While construction was somewhat lower last year, pipe line deliveries and revenues were at a new peak. Net deliveries totaled 224.3 million barrels compared with 172.5 million barrels in 1954, an increase of 30%. Among the three major crude carriers, Trans Mountain Oil Pipe Line doubled its traffic. Montreal Pipe Line Co. increased its deliveries by 27% and Interprovincial traffic was 24% higher. Canadian products lines delivered 18% more petroleum, increasing from 32.7 to 38.6 million barrels. Operating revenues of companies reporting totaled $58.9 million.

A very large proportion of 1956 pipe line construction will be in the natural gas field. West Coast Transmission Co. will spend around $100 million this year (about 75% of the total cost) on its 650-mile big-inch line from the Peace River district to Vancouver, B. C., and the United States border. The line will not be completed, however, until 1957. Other gas line construction is under way in the Prairie Provinces and in Ontario where gas is being imported to supplement local supplies, while a load-building campaign is under way.

Crude feeder systems are being expanded in the west and Interprovincial is busy looping parts of its line. Extension of this major crude line to the Toronto area may be undertaken in 1957 to serve Regent at Port Credit and British American at Clarkson, both of which are building major refinery additions. This project has been rumored for some time and is considered logical but no announcement has been made by Interprovincial.

Product line capacity is being enlarged in the Ontario region.

Interprovincial's 1956 program of looping to cost $9 million, has been made necessary by increases in crude production in Saskatchewan and Manitoba and increases in refinery demand in the east. Michigan refineries now are beginning to buy Canadian crude and Ontario plants are expanding to take care of the rapid increase in Canadian consumption in this area.

The 1956 line looping program is broken roughly into two principal sections in Canada and the United States. In Canada about 67 miles of 24-inch loop will be installed between Carroll and Somerset, Manitoba, together with an additional 1.6 miles of 26-inch loop between the company's Gretna, Manitoba pumping station and the North Dakota border. The contract for this work has been awarded to Majestic Contractors of Edmonton, Alberta.

In the United States, 50.6 miles of 26-inch loop will be constructed. Half of this work lies between the Canadian border at Niche and Bowesmont, North Dakota. The remainder will be installed between points near Plummer and Viking, Minnesota. Anderson Brothers Corp. of Houston, Texas has been awarded this contract.

The 1956 project will see the completion of a line looping program between Cromer, Manitoba and Clearbrook, Minnesota. All the pipe is being supplied by A. O. Smith Corp. of Milwaukee.

In conjunction with the pipe line con-

Frogman Keith Carter, of Vancouver about to start his underwater patrol of Imperial Oil's new products pipe line which crosses under Burrard Inlet near Vancouver. Carter swam under water along the channel in which the pipe rests on the Inlet's bottom and carefully inspected every section. (All photos in this article through the courtesy of Imperial Oil Ltd.)

Western Canada's first pipe line for finished oil products went into operation near Vancouver, B. C., in the autumn of 1955. It now carries various grades of gasolines, fuel oils and other petroleum products from the Imperial Oil refinery on the north shore of Burrard Inlet to a new marketing terminal at nearby Burnaby. From there trucks and railway tanks cars load up to carry the products all over British Columbia.

An operator at Interprovincial Pipe Line's Cromer, Manitoba, pumping station. Behind him is the giant control panel which regulates the flow of crude through the line and detects any irregularities in the flow.

struction, additional tankage is being erected at Cromer by the Horton Steel Co. and an additional 2,040 hp pumping unit is also being installed at this location.

An accompanying map shows the Interprovincial system as of January 24, 1956 with locations for future pumping stations on the Lakehead Pipe Line Co. section in the United States. Capacity of various segments of the line as of December 31, 1955 and anticipated capacity at the end of 1956 are shown below:

Section	1955 Capacity (Barrels Daily)	1956 Capacity (Barrels Daily)
Edmonton—Regina	217,000	217,000
Regina—Cromer	193,000	193,000
Cromer—Gretna	193,000	241,000
Gretna—Superior	163,000	212,000
Superior—Sarnia	147,000	147,000

In his annual report for 1955 T. S. Johnston, Interprovincial president, reported deliveries totaling 80.5 million barrels compared with 67.6 million in 1954. Deliveries to refineries in the United States rose from 1.7 to 5.3 million barrels.

The system earned $7 million or $1.40 per share in 1955 compared with $6 million or $1.20 per share the previous year. Operating revenues rose $5 million to $34 million while operating expenses were cut $184,698 to $5.9 million. Year end investment totaled $226.6 million.

Increased product demand in the Ontario region has caused Imperial Oil Ltd. to expand its Sarnia-Toronto products line extending 195 miles from the company's Sarnia refinery to Toronto with a take-off point at London and a spur line into Hamilton.

New construction will be a 12-inch loop from Waterdown to the company's new North Toronto terminal. The 38-mile loop will add 12,600 barrels capacity a day to Toronto. Additional pumping equipment will be installed at Sarnia, London and Waterdown which will increase the capacity of the whole line by 21,000 b/d. This will bring the total daily capacity to over 76,000 b/d.

Imperial has just completed a 6-mile products pipe line in British Columbia, from its refinery at Ioco on the north shore of Burrard Inlet. The six inch pipe was installed by Marine Pipe Line and Dredging Co. of Vancouver. Major undertaking of the pipe-laying job was the 4,000-foot water crossing of Burrard Inlet. Pipe was laid in water up to 55 feet in depth and laid ten feet under the inlet bottom. In parallels the Trans Mountain line which takes Alberta crude from the oil pipe line terminal on Burnaby Mountain to the Ioco refinery. The two lines are 200 feet apart under the inlet.

When laid, every section was inspected underwater by Vancouver frogman Keith Carter who swam along the line to inspect for faults.

Imperial's products pipe line carries gasoline and other products from the refinery to a new distributing center. The new line has a capacity of 21,000 b/d.

The new 30-acre center which will have office and garage facilities, tankage and tank wagon loading platforms, will be fully mechanized and will have a remote control system. Cost of the new installation is estimated at more than $900,000.

Major problem of the new plant construction was the removal of a small hill from the site. G. W. Ledingham, of Vancouver, who cleared the site, removed 200,000 cubic yards of earth from the hill.

As mentioned previously, deliveries by Trans Mountain Oil Pipe Line Co. were more than twice as great last year as in 1954, totaling 30,653,467 barrels of 83,982 b/d compared with 14,522,087 barrels or 39,787 b/d in 1954. Deliveries have been stepped up since the first of the year as a result of the first offshore shipments of crude to California and increased runs by Pacific Northwest plants.

Early in January, Tide Water Associated Oil Co. lifted a cargo of 118,000 barrels of crude at Westridge, B. C. Again in March Richfield Oil Corp. picked up a cargo of 90,000 barrels of crude for California refining. Average exports to California for the first quarter were thus about 2,300 b/d.

The two United States refineries in Washington took 11.4 million barrels of Canadian crude through Trans Mountain in 1955 compared with 953,403 barrels the previous year. Earlier this year deliveries to Shell Oil Co. at Anacortes, Wash., and General Petroleum Corp. at Ferndale were averaging about 55,000 b/d compared with 31,000 b/d in 1955. The four Canadian refineries in British Columbia served by Trans Mountain are: Imperial Oil Ltd., Shell Oil Co. of Canada, and Standard Oil Co. of B. C. at Vancouver and Royalite Products Ltd. at Kamloops. These refiners received 19.3 million barrels in 1955, an average of 41,000 b/d.

Trans Mountain has recently activated its Blackpool, B. C. pumping station at mile 440 between the Rocky Mountains and the coast range.

The station has been in mothballs since the line was laid. With Blackpool in operation, line capacity with four stations was stepped up to 150,000 b/d. Announcement also was made that a new station will be built at Laurel on the Washington spur line. Pumps will be electric motor driven. The new Laurel station will be completed this year at a cost of $800,000. It will permit a full main line stream of 200,000 b/d.

Last year's construction involved the laying of 27.5 miles of 20-inch and nine miles of 16-inch pipe costing $2,750,000 to serve Shell's new Anacortes refinery. Trans Mountain can increase its ultimate capacity to 300,000 b/d, by the addition of 10 new stations if offshore demand becomes more active and local west coast markets continue to expand. The Westridge marine loading dock has a capacity of 20,000 barrels per hour.

Trans Mountain's earnings improved remarkably in 1955 as a result of the rapid increase in traffic. In 1954 the company lost $1,256,453 after an income tax credit of $1,123,000. This past year net earnings before income taxes totaled $5,866,172 and after taxes $3,086,172, or $2.05 per share. Operating revenue totaled $14,785,429 in 1955 compared with $6,841,299 in 1954. Earnings in 1955 were sufficient to wipe out the 1953 and 1954 deficits and to put the line safely in the black.

A number of field gathering and trunk line feeder systems were built in Western Canada in 1955 and more are under way this year.

Pembina Pipe Line Co., which operates a gathering system in the Pembina field and delivers crude through a 70-mile line to Edmonton will spend $4.5 million this year on its present system. The main pump station will be completed and tankage expanded. About 100 miles of gathering lines will be laid. It is anticipated that 1,200 wells will be connected by the end of the year and that line throughput will be up to 100,000 b/d.

At the end of the company's first fiscal year on Nov. 30 last the company reported an investment of $13.6 million. Profit was 80 cents per share on 400,000 issued shares.

The company also hoped to increase its scope of operations. Application has been filed with the Alberta Petroleum and Natural Gas Conservation Board to build a line south from Edmonton to the new Westward-Ho-Sundre fields. Two other companies are competing for the same privilege. Rangeland Pipe Line Co., a subsidiary of Hudson's Bay Oil and Gas Co., proposes a line from Westward Ho and Sundre to connect with the Texaco system. Third applicant, Cremona Pipe Line, was successful in obtaining the privilege and will build a line to the Calgary area.

Peace River Pipe Line Co. in March of this year announced completion of a 106-mile line from the Sturgeon Lake fields to Edson on the Trans Mountain Line. Capacity of the line is 45,000 b/d, through 12- and 16-inch pipe. A 50-mile gathering system supplements the trunk line. Parts of

the line were laid on the surface during the winter and will be buried during the coming summer. The system will cost about $8 million when completed.

Tariff is 35 cents per barrel from well to Edson. Completion gave producers a price 80 cents per barrel higher than was possible through the former trunk and sail transportation methods. Field price for Sturgeon Lake crude in March was $2.29 per barrel.

The system is expected to deliver 9,000 b/d to Trans Mountain this year. Sturgeon Lake area reserves are estimated at 200 million barrels.

Westspur Pipe Line Co. has begun construction of a 109-mile line from Weyburn district fields to the Interprovincial pumping station at Cromer, Man. Gathering system pipe has been strung in the Midale field, and similar systems will be laid in the Alida, Frobisher, Hastings and Nottingham fields. Main line pipe will be 12-inch. Construction will be completed soon, although field work was badly hampered by cold weather during the past winter. Westspur will spend $6,400,000 on the project.

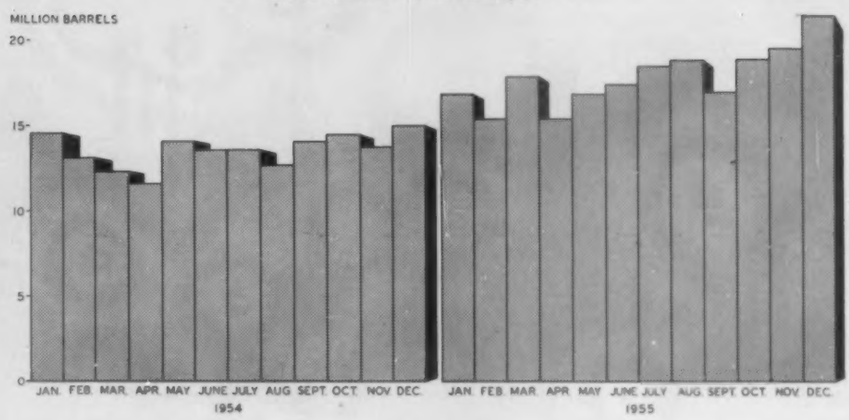
Trans-Prairie Pipelines Ltd. added 22¾ miles to its original 44 miles of line in Manitoba to bring the total to 66¾ miles with maximum 6-inch diameter. This pipe line, which serves the Daly, Virden-Roselea, North Virden and Woodnorth fields in the Virden area, carries about 90% of all the oil produced in Manitoba. It terminates at the Interprovincial Pipe Line Co. pumping station at Cromer, a few miles south of the Daly field. Traffic volume in 1955 was 4,060,607 barrels, with average daily throughput rising from 8,480 b/d in January to 14,000 b/d in December. Net operating profit of the line was $217,072 or 92 cents per common share in 1955.

The Trans-Prairie line features an unusual pumping system designed particularly to suit its operational requirements. Combining low and high pressure pumping, the dual system provides economical operation as well as safety from over-pressure.

In the Daly field, which operates at low pressures, each battery is served by a rotary gear pump, electrically driven. A float switch in the suction line operates to shut the pump down when the tank is empty. High pressures in the Virden-Roselea and North Virden fields are handled by duplex piston pumps, also electrically driven. The best batteries are served by this type alone, but smaller batteries are served by a combination of a piston pump which handles a group of batteries, and individual centrifugal pumps which pump into the suction side of the piston pump.

In this arrangement, there is a pressure switch operated from the discharge side of each centrifugal pump to shut the unit down when the tank is empty. The piston pump in the group is started up first, taking suction from one of the tanks in the battery which it serves directly. Then each centrifugal pump is started in turn, being shut down automatically when its tank is empty. Each piston pump can normally take the production from four batteries at distances up to one mile. The automatic shut-down is effected by a dual stage pressure switch which operates when pressure falls below a pre-set low limit or rises above a pre-set high.

Net oil deliveries of Canadian pipe lines.



In addition to the big-inch gas line under construction by Westcoast Transmission, a number of other natural gas systems are planned or building. North Canadian Oils Ltd. has begun to receive pipe for a 136-mile gas line from Wabamun to Hinton, Alta. Winter work has involved the laying of pipe for crossing the McLeod, Pembina and Wolf rivers. Gas to be shipped through the 10-inch line will be sold to a pump mill at Hinton. Mid-Western Industrial Pipe Lines will build 34 miles of line from its fields in the Alexander Majean Lake and Westlock districts to connect with North Canadian at Wabamun.

Canadian Western Natural Gas Co. Ltd. of Calgary has announced a $5.25 million expansion program for 1956. Ten new communities will be added to the company's distributing system to add 2,500 new customers. About 111 miles of transmission line will be laid this year in addition to the distributing systems in the various communities.

Another industrial gas line is planned by South Alberta Pipe Line Ltd. to move gas 150 miles from the Etzikom field to serve a petrochemical plant near Medicine Hat. Cost would be about $1 million for the 8-inch line.

It now seems doubtful whether construction will get under way this year on the big Trans-Canada gas line. The company has been granted an extension of time in which to complete its financing until Nov. 1, 1956. The deadline for beginning construction has been extended to June 30, 1957. Date by which gas must be exported from Alberta was set forward to Dec. 31, 1957.

Contingent on the Trans-Canada project is the plan of the Alberta Gas Trunk Line Co., Ltd. to spend $47 million on a 547-mile gas gathering system to tap major fields in the Province.

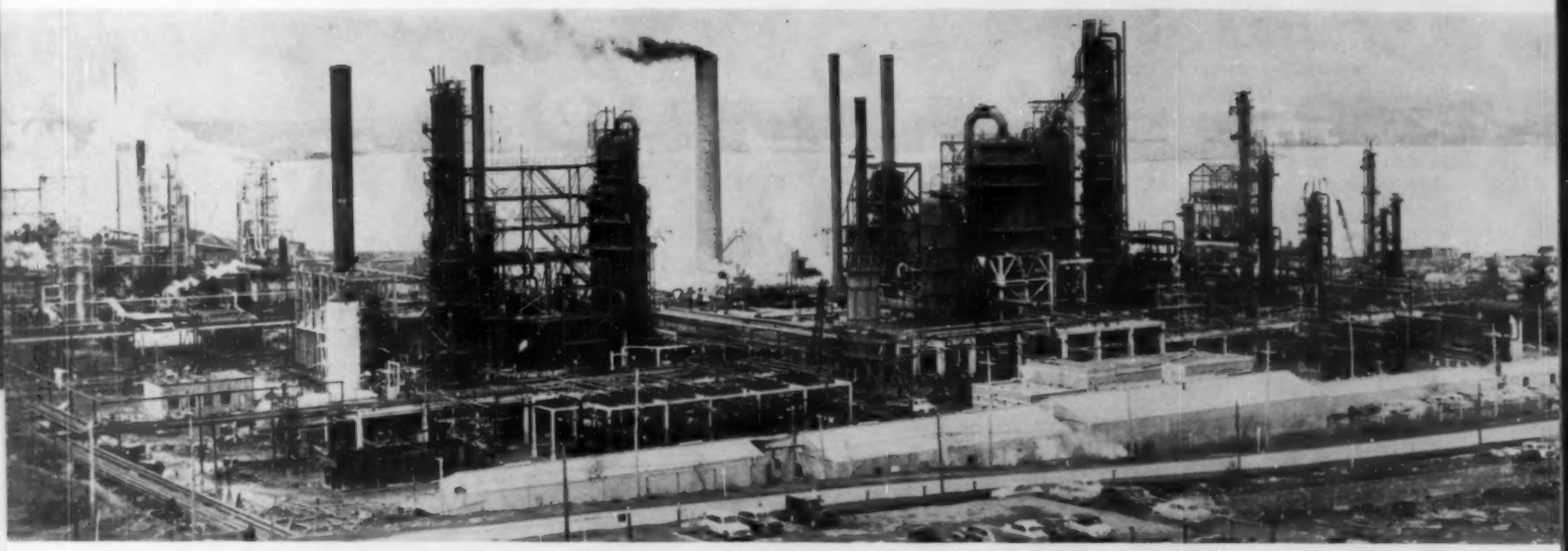
Saskatchewan Power Corp. will spend $10 million this year to bring gas from southwestern fields to Moose Jaw. Service will be given also to Battleford and Humboldt. The project involves 100 miles of 12 or 16-inch line to the Success field. At a later date the company may buy gas from Trans-Canada on a 100% load factor and use Success as underground storage.

In British Columbia 20 car loads of 18-inch pipe started moving through the Fraser Valley in late March as the British Columbia Electric Co. which will sell natural gas bought from Westcoast rushes its Lower Mainland construction program. The company will build 36 miles of 18-inch pipe from Huntingdon near the U. S. border to Vancouver.

Plans are still being considered for the building of a natural gas pipe line from the U. S. end of the Westcoast line to Vancouver Island. This would enable the shortest underwater route to be used as Washington coastal points are closer to the southern end of the island than is Vancouver. Magna Pipelines Ltd. has been studying the pipe line routes to Vancouver Island.

Despite the Trans-Canada delay, there will be a boom in Canadian pipe line construction during the next few years, Carl O. Nickle, member of Parliament from Calgary, told recent meeting of the Pipe Line Contractors Association of Canada.

Cross country mileage to be laid in 1956 will total about 1,200 miles compared with 400 in 1955. In the next five years, Mr. Nickle said 1,500 miles of oil lines and 5,500 miles of gas lines will be laid in Canada. If the industry is free to expand without too much control, Canada may build 15,500 miles of line in the next 10 years. Capital requirements would be $1,000 million in the next five years and $2,250 million in the decade to come.



Imperial's modernized Halifax refinery. Starting from the left is shown the 45,000 b/d two-stage crude distillation unit, the 28,500 b/d (total feed) Model IV fluid cat cracker, light ends plants and 5,000 b/d catalytic polymerization unit.

Imperial's Halifax refinery, a veteran of two world wars, is being completely rebuilt. This $30 million job is currently the largest oil construction project in Canada.

REBUILDING HALIFAX

By K. E. Bentley

LATE this spring, Imperial Oil Ltd. will start up a 45,000 b/sd atmospheric and vacuum unit at Halifax, N. S., marking the first step of a series destined to transform that refinery from one which has become largely obsolete into an up-to-date plant ranking among Canada's larger refineries. This unit will be followed in quick succession by a 15,000 b/sd Model IV fluid catalytic cracker light ends unit, including a depentanizer operating on catalytic cracker light naphtha, a 5,000 b/sd non-selective catalytic polymerization unit, an 800 b/sd LPGas unit and a 7,000 b/sd 300-lb. cyclic regeneration fixed bed platinum catalyst Powerformer having an integral Hydrofiner for feed preparation. The last of these units will be completed by Dec. 31, 1956.

Coincident with the processing unit construction, there is also going forward the provision of major auxiliary facilities to result in an almost completely rebuilt refinery. The complete project will cost in the vicinity of $30 million.

Prominent among the auxiliary facilities are the following: utility plant, oil separators, waste disposal plant, water pumphouse, gasoline line blending installation, additional tankage, addition to mechanical shops, technical building, and two new docks.

Imperial's Halifax refinery is situated on the harbor front on the Dartmouth side, opposite the city of Halifax. Established over 200 years ago as a fortress, Halifax has taken an active part in wartime. Enclosed within the refinery's boundaries is the site of old Fort Clarence, one of the older major fortifications, since dismantled.

In keeping with Halifax's wartime role, Imperial's refinery has been the nucleus of a major refueling base for the allied navies during two world wars. It was built during the first war with that as its first task and expanded for that purpose during the second war. Its peacetime function is to supply the Maritime Provinces, a district having a population of roughly 1.5 million, with the major share of its petroleum products. It is the only large oil refinery in Canada east of the Montreal area.

Crude run is mostly from South America which comes to the refinery docks year round by tanker. Products are shipped out by tanker, tank car and tank truck.

The new refining units will replace a combination pipe still, gas oil thermal cracker, and reduced crude thermal cracker completed in 1939, and two batteries of horizontal shell crude stills completed in 1921. They will also eliminate the need for the gas absorption plant built in 1935.

Foster Wheeler is acting as general contractor for the processing units and the utility plant. In that capacity this firm has done most of the mechanical design based upon specifications and process design detail provided by Imperial. Foster Wheeler has also handled all material procurement and inspection and is presently erecting the

K. E. Bentley, project coordinator for Imperial Oil Limited on the Halifax refinery modernization, was born in Nova Scotia. After graduating from the Nova Scotia Technical College in civil engineering in 1934, he joined Imperial at the Halifax refinery. Following experience in the laboratory, engineering and operating departments, he moved to Sarnia, in 1949, where he is on the staff of Imperial's engineering division. While there, and prior to the start of the Halifax project, Mr. Bentley has been a senior engineer in the operations analysis section dealing with Sarnia refinery for three years, and has been on project work concerned with Montreal, Edmonton and Vancouver refineries.

units with the help of a number of other firms acting as subcontractors.

As might be expected in a project of this magnitude, which amounts almost to a grass roots refinery project, there have been incorporated a considerable number of modern devices, innovations and design features. These are the result both of recent experience by Imperial and others and of studies aimed at adapting proven equipment to new services. It will be the purpose of this article to indicate rather than describe them.

Of the refining units, the A & V unit, cat cracker, light ends and poly plant are controlled from a central control room, using the graphic type of instrument panel of Imperial's design. Extensive use is made of miniature strip chart instruments within the picture part of the panel, tying in to the section of process to which they apply. Serving to further integrate these units, a two-way communication system has been installed which will permit the control room personnel to talk to operators in various parts of the unit and will also facilitate maintenance during unit turnaround.

The A & V unit is of conventional design producing fuel products and cat cracker feed. Heavy naphtha goes through intermediate tankage to the Powerformer. Pitch may be visbroken, used as asphalt base, fluxed to bunker fuel directly, or burned as such for refinery fuel. A crude oil desalter forms part of the unit.

The cat cracker is an Esso Research and Engineering Model IV fluid type, the first of which was placed in operation just over three years ago. Modifications have been incorporated, based on Imperial's experience and that of other companies since that time. A preheat furnace is included to keep the unit in heat balance while running a high percentage of recycle.

New instrumentation features will include a density compensated level recorder installed on the regenerator overflow well and the use for flow measurement of a propeller anemometer on the main air blower discharge to the regenerator.

In place of two stack valves which have been standard practice, serving to take the flue gas line pressure drop in two stages, this unit will have a single valve between the regenerator and the CO boiler or for the alternate operation between the regenerator and the vent stack.

The reactor vessel and the U-bends between the reactor and regenerator are being internally insulated with a view to minimizing metal thickness and producing a consequent reduction in thermal stresses. The U-bends are made by welding together mitred cylindrical sections.

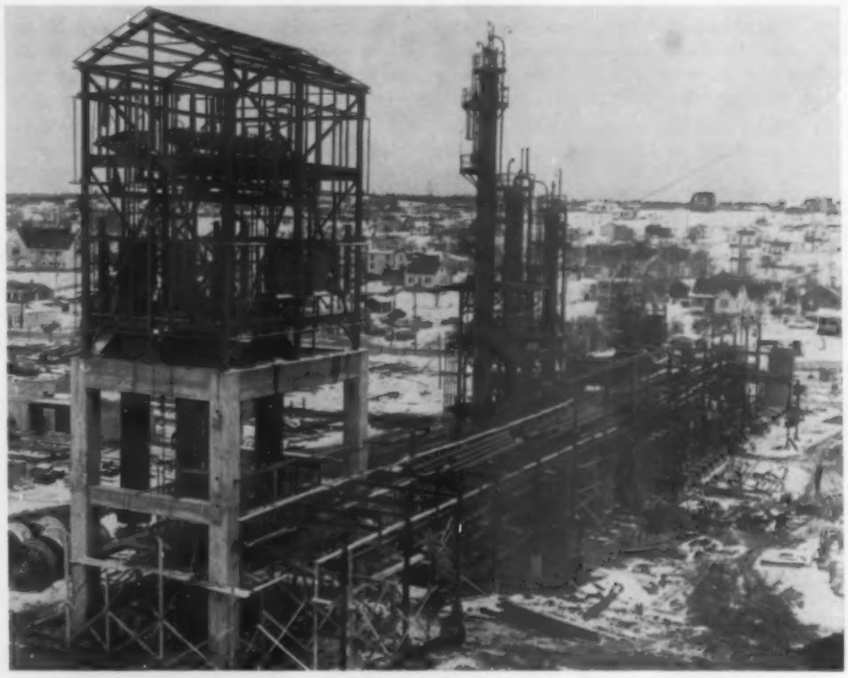
A departure from the conventional type of bubble cap fractionating tray is incorporated in some of the towers of this unit and its associated light ends plant. This is a jet type tray following the Esso Research and Engineering general design. The bottom section of the absorber demethanizer tower associated with the cat poly plant contains a number of float valve bubble trays. These have variable capacity orifices of a special type built into the tray.

All finished streams are to be treated with caustic soda, water-washed and filtered as required at a central treating plant being built near the other processing units. This plant will have its own control house common for all treating systems. Electric coalescers are to be used to separate gas oil emulsions resulting from the treating operation. Both sand and commercial type filters are being installed.

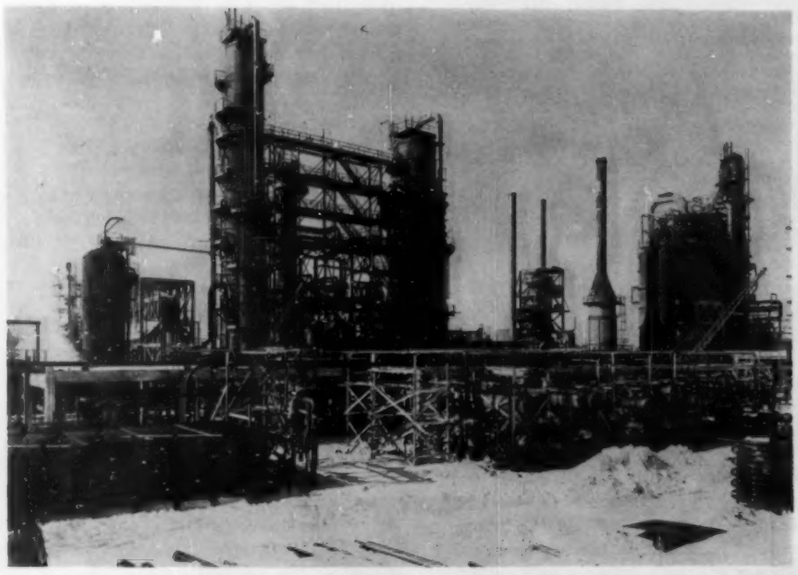
Parts of the existing combination unit are being utilized to make a visbreaker by the addition of modern instrumentation and pumping facilities. This will operate on vacuum pitch. The gasoline produced will be charged to the Powerformer.

The Powerformer will use an Esso Research and Engineering Company type platinum catalyst. Feed to the unit will be a mixture of heavy natural naphtha and visbreaker naphtha. This will receive a pretreatment in a Hydrofiner to be constructed as an integral part of the reformer. A spare reactor is being provided for the purpose of increasing unit on-stream time. Rotary vane type compressors are to be used in the regeneration operation. This unit will have its own graphic type control board housed within the unit area.

The design of all operating units has had regard for maintenance. Alloy materials are extensively used for vessel internals, furnace and exchanger tubing, and pumps. In general, fractionating equipment, pumps and exchangers are separated from one another by roads or accessways having 18 feet and 14 feet overhead clearances respectively and sufficient width to permit the use of mobile equipment. Pumps are unhoused excepting in the steam plant and are arranged either in single or double rows. In the A & V and cat cracking units,



Progress of construction on February 1, 1956. A & V unit in foreground, cat cracker and light ends plant in rear and right hand side of picture. Common control house on extreme right.



View from the other side of refining units showing utility plant in the foreground.

they are roofed over with a concrete slab, above which is a main pipe run. Platforming gives access to all manholes and may be served by either stairways or ladders. Manholes face on accessways. Painting will be according to the modern multi-colored plan segregating the various units and improving the appearance of the area.

A steam-generating station consisting of three boilers each of a capacity of 125,000 pounds per hour at 625 pounds pressure, is being built replacing the one built in 1917 now being operated. A building is provided to house their control equipment and pumps and to contain lunch and locker room facilities. This building also contains air compressors serving the whole refinery for instrument and general use. The plant is immediately adjacent to the processing units.

A noteworthy feature is that one of the steam generators is designed to be fired on CO, utilizing the waste gases from the cat cracker. These can be diverted, using a liquid seal arrangement, either through the CO boiler or to the atmosphere. The boiler can also be fired by the more conventional liquid and gaseous fuels.

Electricity is being supplied by the Nova Scotia Light and Power Company through its network at 23,000 volts to satisfy a load of 8,500 kilowatts. The power company is constructing some five miles of 69,000 volt line to reach this area and is providing step-down transformers at the refinery site. Seven substations are being built by Imperial to distribute the electricity at 4,160, 440 and 110 volts. Advantage is being taken of the general modernization program to convert several 25-cycle installations still remaining from the early construction so that in future there will be only 60-cycle within the refinery.

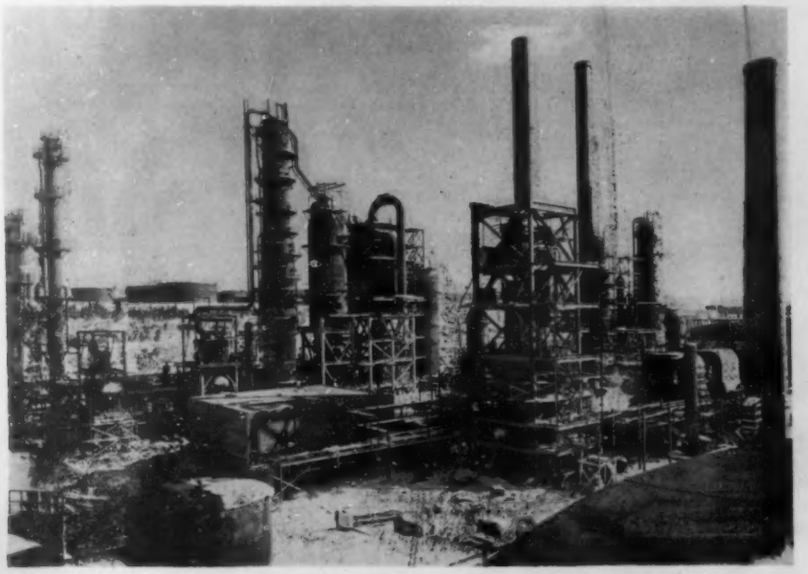
The old refinery sewerage and oil separator installation is being retained but as it is loaded to capacity, it is being supplemented by a complete new installation. This consists of two new trunk sewers for relatively clean water and for oil-bearing water from the new processing units to two new circular separators designated the clean water and oily water separators respectively. These units are provided with continuous sludge removal and oil-skimming facilities.

A new waste disposal unit is being provided. Separator emulsions and sludges as well as tank bottoms and other similar oil bearing materials will be processed at this plant by a two-stage centrifuge system. The recovered oil will be rerun. The dry cake will be disposed of by burning in an incinerator to be provided for this purpose.

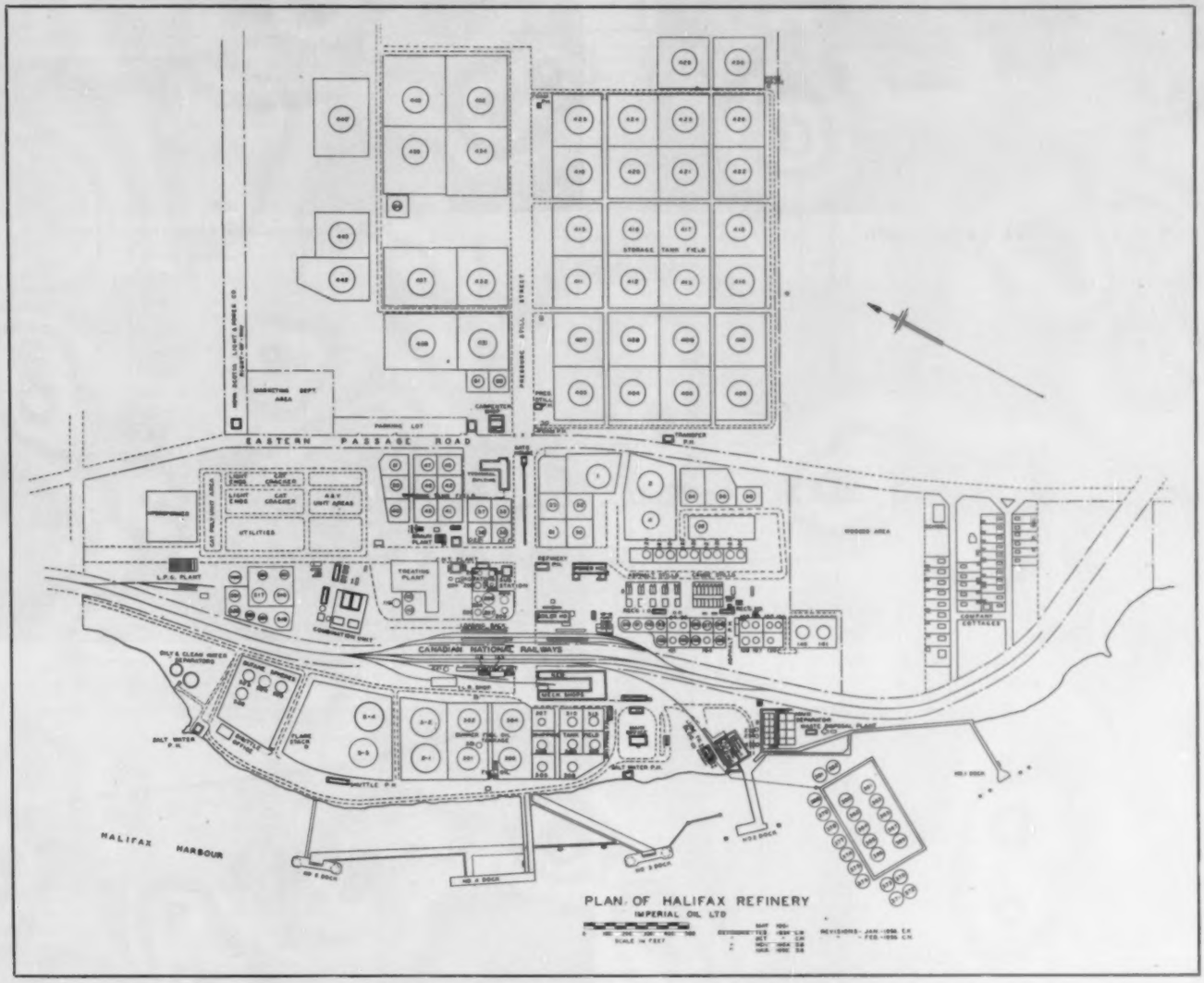
The disposal of waste gases will be handled through the use of two new flares, one of which is the elevated stack type equipped with a smokeless burner; the other is a ground level burner confining the flame within a refractory lined stack. Caustic soda used in treating will be neutralized by flue gas prior to discarding it to the sewer. Naphthenic acids are being segregated and marketed as a by-product. Malodorous gases are being directed to the flares. The use of the foregoing facilities will serve to minimize the pollution effects normally associated with oil refineries.

Both fresh and salt water cooling is provided with use of the former confined to such services as pump gland cooling where corrosion or salting up would be serious factors. Mechanical cleaning of the mile long supply line has assured ample capacity for the new requirements. Corrosion due to use of salt water cooling is being minimized by the use of aluminum brass tubing and by neoprene lining the other parts of exchangers in contact with water. Sewers are cast iron, concrete lined, within battery limits with reinforced concrete trunk lines outside battery limits. The new incoming water main from a new pumping station is reinforced concrete.

A feature of the extensive program of offsite piping construction is the modernization of the refinery's continuous in-line gasoline blending system. The original installation in 1936 pioneered this type of gasoline blending. It has been used exclusively at Halifax since that time, successfully blending directly to tankers or to tankage for tank car or tank truck loading. The new system will be similar to the old one but with increased capacity, and a



Catalytic polymerization plant with reactor structure in foreground, February 1, 1956.



Refinery layout as it will be after completion of the new construction.

more modern type of electric transmission ratio flow controllers.

Automatic blending is also to be used on the pitch stream going to bunker fuel, adding flux to a specified product viscosity.

Of the approximately 1.3 million bbls. of new tankage being provided, five tanks totalling 0.5 million bbls. will have floating roofs. These have not been installed as extensively in Canada as in warmer climates, but based upon Imperial's experience at other refineries, and upon the use at Halifax refinery for many years of a single similar tank installation, no difficulties are anticipated. Spheres are being installed for containing butane, horizontal pressure tankage for propane and a single hemispheroid for pentane. An investigation of the underlying slate strata was made by test borings resulting in a decision against underground storage for these products.

What amounts to a complete new mechanical shop and storehouse has been achieved by joining three existing buildings and adding to them. Two of these were formerly in this service. The third is the old laboratory building. Extensive use is to be made of palletizing and mechanical handling equipment in the new storehouse. A number of new machines are being installed in the shops. The new construction will consolidate all mechanical trades in one building for the first time at this refinery. New and modern types of mobile handling equipment have been purchased for general use.

A new technical building houses the laboratory in one wing with the second containing medical, personnel, technical and management offices. Provision has been made in the design to add a third section for general engineering and accounting offices if the future proves it is desirable to move them from their present location in the old office building.

Docking facilities which had been expanded during the last war by temporary wood pile structures later dismantled, are now being thoroughly modernized. One old dock still in service will be dismantled. Another, built in 1935 of ballasted reinforced concrete cribs, will be brought up to date by the provision of spring and rubber fenders and modern hose handling facilities.

Two new docks are to be built to a design employing for each of them two circular, steel pile shell, sand-filled cribs joined together and to the shore by steel pile structurals supporting pipelines and roadways. These will both have the same type of hose-handling facilities and fendering as are to be provided on the one being modernized. Manual labor is being minimized by providing electric capstans and complete electric hoist systems for placing the dock hoses in position at the ship's hose connections. The arrangement is achieved by terminating the dock face of the piping within an elevated structure which also supports the hoists and serves to stack the hoses which will remain connected on the shoreward end at all times.

The new docks are sized to accommodate tankers up to 38,000 dwt. Pipelines servicing them will permit discharging crude at 20,000 bbls. per hour and loading products at 7,500 bbls. per hour.

Drayton Valley, 1952, before the discovery.

Original town planners' office, Drayton Valley.

Trailer court, at Drayton Valley.

Company housing starts in Pembina.

Drayton Valley, 1955, hotel and shops.

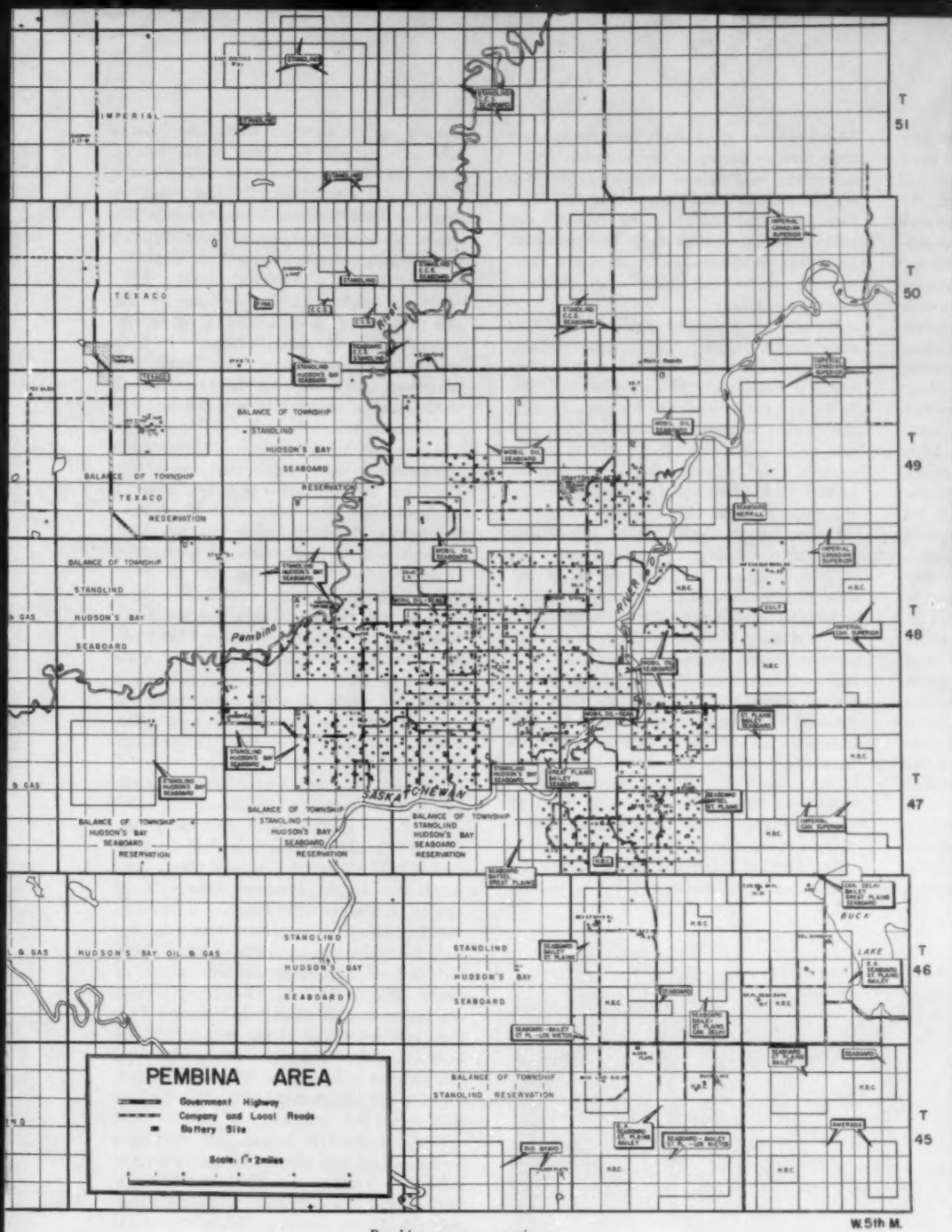
Drayton Valley, 1955, more shops.

One of the authors, James E. Sayers.

PEMBINA PROGRESS

By E. M. Blanchard[1] and James E. Sayers[2]

Last year 650 wells were completed in Pembina, bringing producing capacity to 160,000 b/d. This year 700 more wells will be completed. Special bit tooth designs have speeded drilling and reduced core damage from small iron. The power drilling sub has helped recover 60-70 feet of uninterrupted core.



Pembina area concessions.

A drilling rig in Pembina.

IN THE summer of 1953, a wildcat was drilled in the Pembina area 70 miles southwest of Edmonton, Alberta. Socony-Vacuum drilled this discovery well on a farmout from the Seaboard group. Production was found in the Cardium Sand (upper Cretaceous) at the interval from 5,339 feet to 5,357 feet. The oil was 37 gravity and the well showed a potential 500 to 600 barrels a day. The oil was water-free with a gas-oil ratio of 350 cubic feet per barrel.

By the end of 1955, $75.2 million had been paid to the Alberta Government for Pembina acreage with more sales slated to follow. The largest land holders in the area are Stanolind Oil and Gas Company, Mobil Oil of Canada, and Seaboard Oil Company. Large adjacent holdings are held by California Standard Company, Imperial Oil Ltd. and The Texas Company. In addition, several other companies hold acreage throughout and around the area.

Booming headquarters for the Pembina activity is the town of Drayton Valley. At the start of the activity, Drayton Valley was a tiny crossroads hamlet with no more than a few houses and a general store. Today, it is a carefully planned community with a nice theatre, hotel and shops. Neat company houses are being built, and eventually it will be a model town. Nearly all the service and supply house companies are represented, and there are several modern oil company buildings.

The progress of this promising new oil producing area is actually two stories. First, it is a record of important new oil finds and increasing oil production. Second, it is the story of unusually tough drilling and development problems and how they are solved—how modern oil men overcome weather, build model communities in the wilderness, construct roads over treacherous muskeg, and develop new tools for drilling conditions peculiar to the Pembina area.

During the first week of 1956, the rapidly expanding Pembina sector replaced Redwater as Canada's top crude oil producing area. During that week, Pembina's 816 wells poured out a daily average of 79,340 barrels compared with Redwater's average daily production of 77,770 barrels from 907

[1] *E. M. Blanchard is president of Alberta Oil Tool Co. Ltd., Edmonton.*

[2] *James E. Sayers is northern regional sales manager for Security Engineering, Division Dresser Operations, Inc., Denver, Colo.*

wells. At the end of the year, the Pembina wells had a capacity exceeding 160,000 barrels per day.

In 1955, 650 wells were completed. At least 700 more should be added by the end of 1956. The field should have a production of around 147,000 barrels daily allowable by the end of the year. Today, it is estimated the field will ultimately have a proven area of 400,000 acres and a reserve of 1.5 to two billion barrels. Using 80-acre spacing, there should eventually be 5,000 wells on these 400,000 acres.

Nearly all production in the Pembina field taps the Cardium Sand at from 4,600 feet on the east flank of the field to 5,800 feet on the west. Average thickness of the net pay sand zone is 25.4 feet. Since the western limits of the field have not yet been definitely outlined, the field could conceivably be larger than its present estimate. Down dip does not indicate any water table but rather a lessening of porosity.

In the foothills, 75 miles west of the proven field, Cardium out-croppings have been found measuring up to 200 feet thick. The search is on in this vicinity. It is quite possible more finds could be made here. Should this happen, Pembina would become a veritable oil empire. Should the search be fruitless, the rugged terrain and the weather could make it an empire of headaches. Only time can tell. At Rocky Mountain House, 70 miles to the south of the proven field, commercial Cardium production has been obtained. In the Cardium Belt between, more finds may be made—thus further enlarging its potential.

Drilling in Pembina separates the men from the boys. During the spring and summer rains, the ever present muskeg can suck a tractor out of sight. Temperatures of 30 and 40 degrees below zero are common in winter, and treacherous blizzards blow up suddenly.

Recently, a blizzard caught a drilling crew round-tripping. The derrick man was fresh from the South, and this was his first blizzard. Repeatedly, he called to the driller to let him come down for his coat. Finally, the driller took pity on him and allowed him to come down. Reaching the floor, the derrick man walked into the dog house, picked up his lunch pail and headed down the steps towards his car.

"What about your coat?" the driller called after him.

"It's in Texas," replied the departing, shivering derrick man.

Another problem for Pembina operators is the muskeg, making road building tough and expensive. Muskeg is plant life in a state of decay and decomposition. Overlaying ordinary soil such as clay, the muskeg averages from one foot to 100 feet in depth. It can hold several times its weight in water. Swamp spruce and tamarack can grow in it. The forest growth life cycle provides an ever-increasing depth to this dead vegetation. Unfortunately, most of the Pembina locations are in the muskeg.

To date, the government and the oil companies have spent about ten million dollars on all-weather roads. At least a like amount will be spent in the future. Cost for these all-weather roads range from $8,000 a mile for side roads and rig roads to $30,000 a mile for main roads. Rig roads often terminate in a gravel drilling pad, usually tear drop shaped and approximately 160 feet in diameter.

Where muskeg makes grading a rig site prohibitive, directional drilling several holes from one prepared "island" has been successfully undertaken. Production has also been obtained using this technique to drill under a river. More of this work is contemplated.

A pontoon bridge and one conventional bridge have been constructed across the Pembina River, and operators hope a bridge will eventually span the North Saskatchewan River which divides the field. In winter, this river is crossed on the ice. In summer, crossing is by ferry.

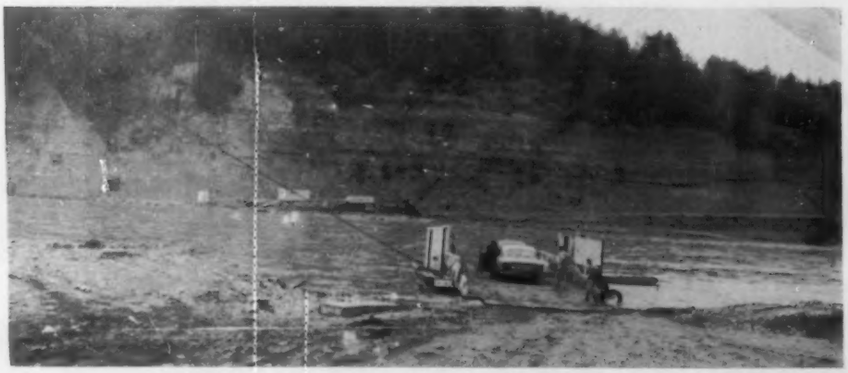
As roads are built and drilling rigs move in, wild game in the area is gradually retreating. During the summer, however, black bears are still a common sight on the fringes of the town. On one occasion, a bulldozer, while clearing a location, uncovered a mother bear and her cub. The mother bear had to be shot, but the cub went to the zoo.

Despite muskeg, bears and blizzards, however, enterprising operators and contractors are getting more and more rigs into this rapidly expanding field. At the end of 1955, there were around 60 conventional rigs in the Pembina area with 51 operating. Before 1956 is over, there may well be more than that. Nine-inch and 8¾-inch holes are the rule after setting about 610 feet of 10¾-inch surface casing in either 13¾ or 15-inch hole. Long strings are seven-inch in nine-inch hole and 5½-inch in 8¾-inch or in the occasional 7⅞-inch hole. Most wells use permanent-type completions with Sand Frac treatment, occasionally augmented by the use of mud acid.

Many of the first holes drilled in Pembina used jet bits. By adding larger pumps tailored to jet usage and by the use of more drill collars, it was found drilling time was reduced. Later, however, when the same big pumps and drill collars were used with conventional bits, equally good records were obtained. Time and footage comparisons between jet bits and conventional bits indicated there was little to choose in either's favor. Each was able to get roughly the same results with the cost of the conventional bits considerably less than the cost of the jet bits. Today, drilling with jet bits is the exception rather than the rule in Pembina.

After roads are built, locations cleared and rigs up, Pembina still presents a number of peculiar drilling problems. One of the most serious of these problems during the early development of the field resulted from an unusual amount of bit tooth breakage. Most of the Pembina drilling is in sand and shale, calling for use of long toothed bits. When a conventional long toothed bit was used, however, considerable tooth breakage often occurred as the

A ferry starting to cross the North Saskatchewan River during the summer.



The North Saskatchewan River covered with ice.

bit drilled through a shale section and entered a fairly firm sand. No serious trouble ensued from this until the time came to diamond core. Then, several time-consuming runs with a magnet and junk basket were necessary to clean the hole of junk. Otherwise, the diamond core bit would be damaged by the broken teeth and other small pieces of iron left in the hole.

Even after these magnet runs, the diamond core bit still frequently came out of the hole mutilated because of the necessity of adding a single connection while taking the 60- 70-foot core. Pulling up and adding this connection allowed junk missed by the magnet and lodged in the mud cake to drop back into the core hole. In Pembina, during the last year and a half, two tools aimed at correcting this trouble have been developed. These are the Security S3P ("P" for Pembina) Long-Toothed Rock Bit and the Power Drilling Sub. A description of these successful tools follows:

The S3P—In the fall of 1954, a team of engineers from Security Engineering Division of Dresser Industries, Inc., came to Pembina to attempt to solve the tooth-breakage problem. The operators were most cooperative; they, too, wanted to solve the problem. Test bits were run for only an hour or two and then pulled green to see what happened. It was found that most breakage occurred during the first hour or two while the long, thin-toothed bit was still sharp. The thin tips of the teeth broke off early, leaving the blunter base of the tooth to do the remainder of the work. Therefore, the engineers reasoned, a slightly shorter, wider tooth should stand up, with a longer tooth life, and still dig at least as fast. An experimental Security bit with a tooth 1/16th inch shorter and with a 43 degree angle, compared to the previous slim tooth angle of 37 degrees, was designed and tested. The digging pattern had to be changed slightly but several such models were manufactured and subsequently tested in Pembina. Tooth breakage was reduced to a minimum. It was also found that with increased weight, the penetration rate was speeded over that of earlier, longer-toothed bits. Best of all, the shorter, wider teeth bore the weight. So the bit was put into production.

The first Security S3P Rock Bit was run in November, 1954. Because of its exceptional resistance to tooth breakage, plus its high penetration rate, this bit today has wide usage in Pembina. Following exclusive use of S3P bits, magnet runs on many holes return only four or five ounces of steel shavings or none at all. Before the S3P was developed, two or three magnet runs before coring frequently brought out five or six pounds of broken teeth and junk. Use of the S3P has, in many cases, eliminated altogether the need for magnet runs before coring.

As an example of just what has been accomplished, along with generally improved practices gained from experience, here is a record for all holes drilled in Pembina field during the summer and fall of 1954 prior to the S3P's development, contrasted to all holes drilled in the spring and summer of 1955, after the S3P was born:

	Summer-Fall 1954	*Spring-Summer 1955*
Average penetration rate on surface	30.23 ft./hr.	40.7 ft./hr
Average number of bits (or hole openers) on surface	2	1.4
Average number of drilling bits below surface (no core bits)	11.4	9.7
Average time from spud to spud	20.3 days	16.2 days

The power drilling sub was originally designed and developed to replace the rotary table, kelly and kelly bushings on well servicing rigs to perform the necessary rotational functions required on workover jobs such as drilling up cement plugs and retainers.

When the problem of diamond core head damage, due to small iron in the hole, appeared in Pembina, it was discovered that this damage often was caused by the necessity of breaking off the core and pulling out of the rathole to make a connection. Since the Cardium cores varied between 60-75 feet in length, some way had to be found to take an uninterrupted core. The operators felt that the small iron on bottom could be pumped up the hole out of the way of the diamond core head by utilizing the annular space between the 7¾-inch core head and the nine-inch hole. However, once coring had started and it became necessary to break off the core and come out of the 7¾-inch hole, this same iron fell to bottom, below the diamond core head, where it was then impossible to pump it up the hole because of space restrictions.

Mobil Oil of Canada fostered a program whereby a power drilling sub was constructed of sufficient size and power to turn the drilling string while coring in the Cardium section.

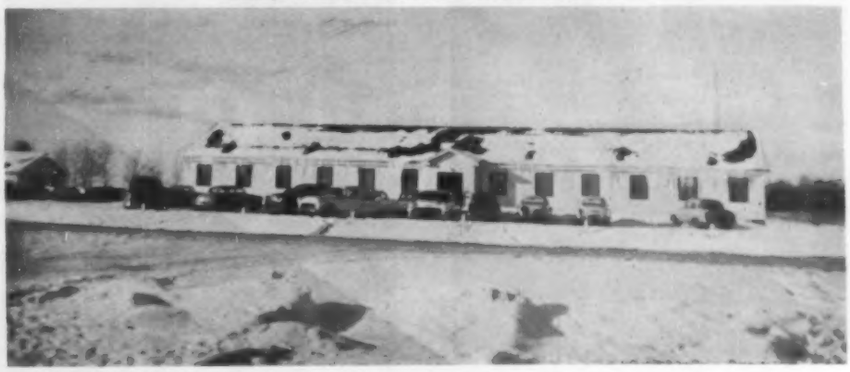
The resultant power drilling sub operates as a tool which is screwed to the rig swivel and then connected to the drill pipe. It is powered with hydraulic motors which will develop a maximum torque on the drilling string of 4,500 foot/pounds at speeds ranging from 0 to 135 rpm.

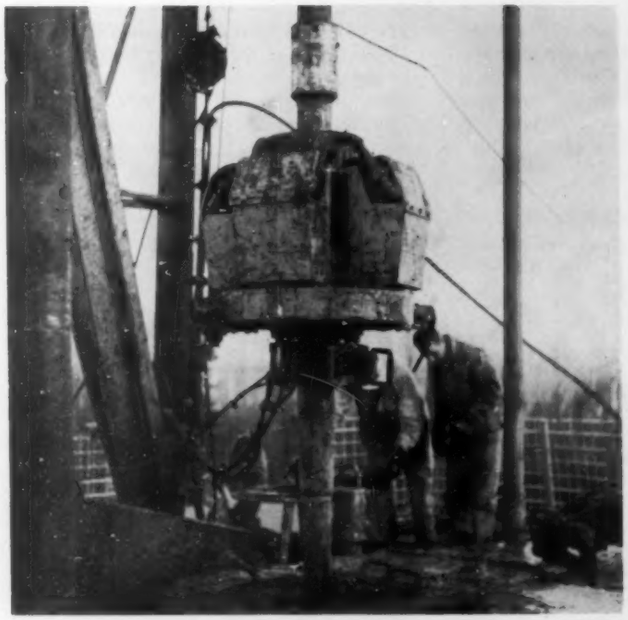
To prevent rotation of the power drilling sub and swivel, torque arms are extended to either side of the swivel when mounted in the rig. These arms are connected by a sliding yoke into a tight piece of ⅝-inch cable. This cable is strung from the substructure on one side of the rotary table to the fourble board, out of the way of the blocks and returning to be fastened to the substructure on the opposite side of the table. This line is then tightened sufficiently to take the torque developed from turning the drilling string.

Motive power for the sub is provided by a diesel engine of 135 maximum horse-

Headquarters of Mobil Oil at Drayton Valley.

Headquarters of Stanolind Oil at Drayton Valley.





A four-motor power sub rigged up.

The four-motor power sub mounted in derrick.

power, which drives a hydraulic pump. The pump has a capacity of approximately 150 gallons per minute with pressures up to 1,500 psi. Engine and pump are skid-mounted together with necessary hydraulic fluid reservoir, heat-exchanger and hose reels to carry the necessary amount of two-inch high-pressure hydraulic hose to make connections to the component parts of the power drilling sub at the rig. The skidded unit is placed on the ground below the derrick floor.

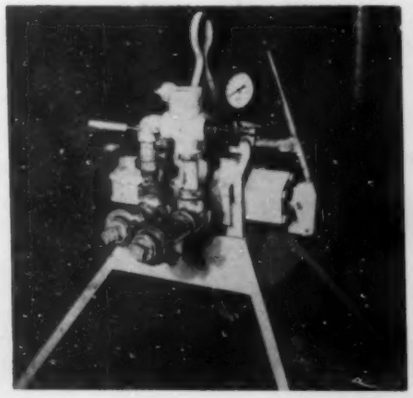
Hydraulic fluid under pressure travels through the two-inch hose to a control stand on the drilling floor, consisting of a four-way metering valve and bypass valve system. This provides a control for rotation speed, maximum torque and reversal of the sub. From the control stand, the fluid continues through connecting hoses to the power drilling sub, which is supported by the traveling block and provides the necessary power to turn the drilling string. Return lines from the sub to the control stand and thence to the power unit are also provided.

When the eighty-foot diamond core barrel has been run to bottom, the power drilling sub rigged up and connected, the following procedure is used: With core head off bottom, the mud pumps are oper-

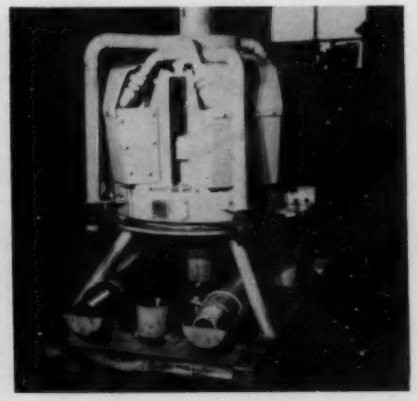
(*Continued on page* 140)

The Security Engineering (Canada) house the S3P built at Drayton Valley.

Control stand with power drilling swivel.



Closeup of four-motor power sub, skid-mounted.



Skid-mounted power unit.

Alberta increased her dominant role in the Canadian oil scene in 1955. Almost 70 per cent of total Canadian oil expenditure was in Alberta.

EXPANDING ALBERTA

By J. W. Thompson[1]

ALBERTA, the center around which Canada's oil industry is growing, established records in all phases of the industry in 1955, and all indications are that it is headed for another banner year. An infant in the industry, it is showing fast, steady growth under intelligent leadership from both the industry and government.

In considering Alberta, a yardstick must be used for comparison. This yardstick should be Canada as a whole; because in terms of oil, Canada is Alberta or 90% of it. Certainly, Western Canada is 99.5%. If any other comparison is required, suffice it to say Western Canada oil reserves are one-eighth those of the U. S., production is less than one-sixteenth that of the U. S., while exploration and marketing expenditures are as crumb to a loaf.

Now consider these facts:

The development of the industry in Western Canada on a hectic scale began with the discovery of the Leduc reef field in 1947, less than 10 years ago.

At that time oil reserves were very small. Today they are estimated at 3.8 billion barrels, 3.5 billion in Alberta, 0.25 billion in Saskatchewan and 56 million in Manitoba.

Oil industry expenditures in the west ten years ago were about $15 million per year. In 1955 expenditure in all phases was $522 million. Spearheaded by pipe line building, 1956 spending could reach $1.4 billion. A key factor here, of course, is whether Trans-Canada Pipe Lines' all-Canadian route to serve the east and to feed a portion of the U. S. Midwest, gets started. This depends, at the moment, on whether Tennessee Gas Transmission and Midwestern Gas Transmission get the nod from the F.P.C. on the exchange of Canadian and U. S. gas.

The main competition this natural gas project seems to have at the moment is that of the politically-generated variety, calculated to heat only under the collar. The majority of Canadian opinion is that much harmony and progress could be made if the combatants could see their way clear to dance to the Tennessee Waltz.

Of Western Canada expenditure in 1955, $363.5 million was spend in Alberta, $96 million in Saskatchewan, $33 million in Manitoba and $30.3 million in British Columbia. This and more will be spent in 1956, with British Columbia showing the greatest percentage increase. This evolves because of the advent of the Westcoast Transmission pipe line from the Peace River district to B. C. and Alberta to the U. S. Pacific Northwest.

Cost of this line is set at $152 million. Some $8 million will be spent on a gas processing plant at the head of the system. Main portion of the line is in British Columbia with a trunk into Alberta. Trunk and laterials will cost $9 million in B. C. and $1 million in Alberta, with other facilities making up the balance. British Columbia will supply 240 mmcf of gas daily and Alberta 180 million.

British Columbia exploration expense will soar in 1956. Right now there are more rigs active in the northeastern portion of the province than at any time, 14. This portion is near the Alberta boundary. They still seek oil, but keep getting gas. There are only two commercial oil wells in B. C. These were both drilled a few miles west of the Alberta border by the National Foothills Agreement group of Texaco (Operator) Mobil, Gulf and Shell.

Expenses on pipe lines will be of the major variety in Alberta, Saskatchewan and Manitoba, whether the Trans-Canada project gets under way or not. However, if it does it can mean $107 million to Saskatchewan and $102 million to Manitoba. In Alberta the first of the two links of the Alberta gas trunk line would be built. This system will cost $47 million and feed Trans-Canada at the Alberta-Saskatchewan border.

This is only the major gas pipe line phase, as now known. In March the Rocky Mountain Pipeline Co., capitalized at $10 million, applied for federal incorporation. It is keeping mum. Both Westcoast Transmission, and Inland Natural Gas in B. C., are the principals behind it. It seeks to export gas across provincial and international boundaries and the target may be the Spokane market in the U. S. and the industrial market at Trail, B. C. It would be fed by Westcoast.

Along with gas, but often given too little consideration, are the by-products. Propane, butane and other gas by-products markets have not escaped attention from the industry. This infant is about to be born. With the advent of the gas pipe lines, marketwise companies are preparing to capture the markets for butane and propane. Processing plants at the wet gas fields are established and on the drawing boards. More in the till of the investors. Latest proposal is a line from Edmonton, via wet gas field routes, to markets in Western Canada which cannot be reached by gas pipe line. Eventually propane and butane will go to the Lakehead and farther.

Along with the gas comes sulfur. With some gas fields yielding up to 35% and no adequate outlet for supplies, there is fear of depressed prices, once gas sales reach their potentials.

Obtaining markets is now the problem of the oil producers. Western Canada production in 1955 averaged 352,000 b/d while Ontario and the Northwest Territories each produce about 1,000 b/d without much deviation. Production was up 35% from the previous year. Production this year has run between 440,000 and 450,000 for the three western provinces. Alberta's February allowable was 423,000 b/d. The April allowable is 356,515 b/d, cut back more than 40,000 b/d from the original because of a strike called at Shell's Anacortes, Wash., refinery.

Slightly less than one-third of Alberta crude production is being marketed in the U. S. Saskatchewan is marketing some 15,000 b/d in the U. S. Midwest. The Midwest and the U. S. West Coast appear to be the best potential markets for Canadian crude. This is where ever-rising production must go. The big Montreal market is not available to the west. The effort of the majors there is concentrated on using as much South American crude as possible—getting the return on that investment while the getting is good.

Talk of price rises for crude in the U. S. of from 35 to 50 cents per barrel hold some promise that a greater market for Western Canada will develop because of the favorable competitive position in which western crude would find itself by the advent of any such boost. Meanwhile, offshore shipments to California raise hopes that more will follow.

The greatest development in 1955 took place in the Pembina Cardium field. On Jan. 1, 1954, it had one well, it now has 1,000. It is producing 90,000 b/d. There are a potential 5,000 well sites and the field is by no means delimited.

Exploration-wise, the discovery and development of the Sundre-Westward Ho-Harmattan area, centered some 65 miles northwest of Calgary, was the bright spot. Development was such that Home Oil's subsidiary, Cremona Pipe Lines Ltd., has gained the franchise for a pipe line to the Calgary area. This will supply 10,000 b/d to three refineries in the area. The Elkton area, adjoining Harmattan, has proved productive of prolific gas, and the whole district is in the process of fast expansion.

Saskatchewan showed considerable expansion. With activity centered in the southeast and southwest, the Steelman field was discovered and 34 wells drilled. At Nottingham, where one well existed at the end of 1954 there are now 48. There were 126 wells drilled at Smiley and 105 at Cantuar. This crude goes mainly to the U. S. Midwest. There is every reason to believe this expansion will continue through 1956.

This activity led to drilling records. Footage was as follows: Alberta 8.4 million, British Columbia 190,000, Saskatchewan 3.2 million and Manitoba 683,000 feet. There were 270 rigs active in the west at the year-end, more than at any time. It is estimated 15 million feet will be drilled this year.

[1] Associate Editor, *Myers' Oilweek.*

Although production and drilling rose about one-third, no major discoveries were reported. Saskatchewan accounted for the largest number of discoveries. The Mississippian brought in the most significant.

Footage drilled and crude production rise sharply in WESTERN CANADA

John A. Downing is vice president of Link, Downing & Cooke, Ltd., consulting geologists Calgary. He has been associated with Dr. Link since 1950 when he resigned as geologist for Pacific Petroleums Ltd. He has been associated with development in western Canada throughout the period of active development. He has prepared special reports for WORLD PETROLEUM *each year for the past three years.*

By John A. Downing

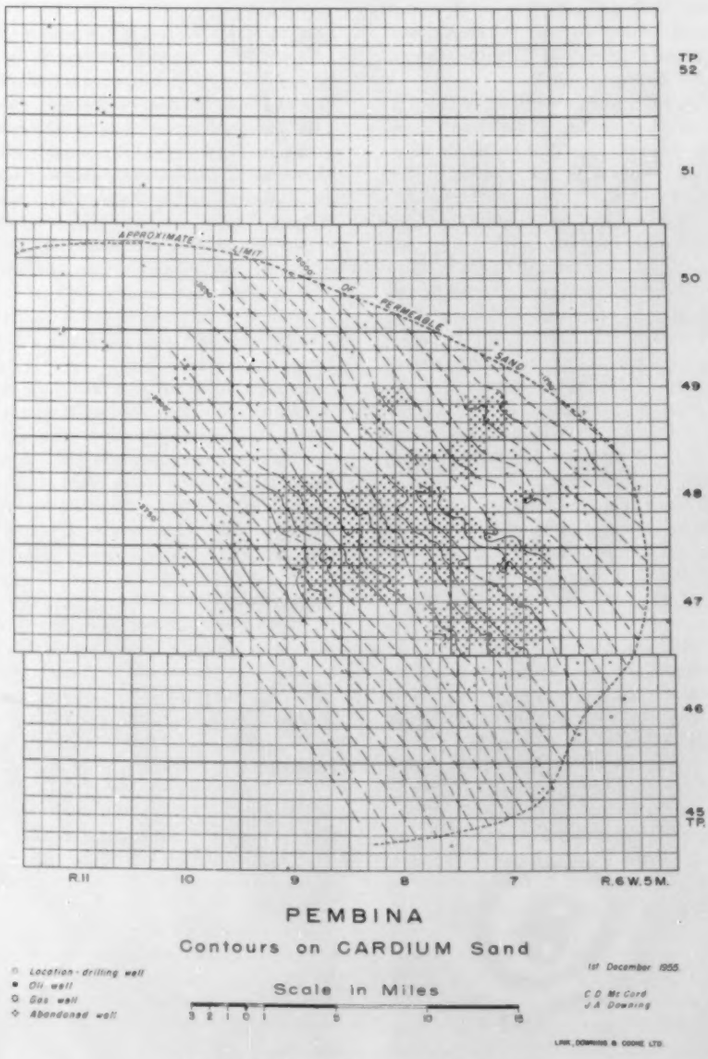


FIG. 1. *Pembina, contours on Cardium sand.*

THE year 1955 was one of steady expansion for the oil industry in Western Canada. Production increased by approximately 34.7% over 1954 and total footage drilled increased by 38%. The exploratory effort discovered several intermediate size oil and gas pools and many minor oil and gas pools but, so far as is known at present, no major pools. The oil reserves of Western Canada have been increased to over 4,000-000 barrels.

The oil discoveries were made in sediments of nearly all age groups, but the most significant were in Mississippian sediments. Geographically, the majority of the discoveries are confined to southeastern Saskatchewan.

This review includes reviews of production and drilling activity, geological distribution of oil reserves and of the most important discoveries and extensions of known fields.

Production—Crude oil production from Western Canada increased by 35% over that of 1954. The bulk of the crude was produced from fields in Alberta, but the production in Saskatchewan has reached significant proportions. The following table shows the production for the last two years. (None of the fields in British Columbia have an established market.)

CRUDE OIL PRODUCTION
(Thousands of Barrels)

Province	1954	1955	% Increase
Alberta	87,714	113,035	28.8
Saskatchewan	5,421	11,300*	108.4
Manitoba	2,148	4,145	92.9
Northwest Territories	370	370**	0
	95,653	128,850	34.7

*December production estimated.
**August to December production estimated.

Although there are 186 oil fields or pools in Western Canada, the bulk of the crude was produced from 25 fields in Alberta, Saskatchewan and Manitoba. These fields and their production are shown in Table I.

Over 13% of the crude produced in Alberta during 1955 was sold in markets in the United States. This represents a considerable increase from the 1954 sales. A comparison of the disposition of the crude produced in Alberta is shown in Table 2.

During 1955 total drilling activity increased in all areas except the Northwest Territories. The increase is mainly due to the number of development wells in Pembina (Alberta), in the oil fields in southeastern Saskatchewan and to development of gas fields in Alberta. Table 3 is a comparison of the 1954 and 1955 total drilling activity in Western Canada.

In all of Western Canada during 1955 there were 2,050 development wells and 885 exploratory wells which accounted for a total of 8,737,680 feet and 3,978,114 feet respectively. One hundred and forty-eight of the exploratory wells were reported as oil discoveries and 98 as gas discoveries. One hundred and seventy-three of the successful exploratory oil and gas wells are new field wildcats or new pool wildcats. However, it is doubtful if more than a small percentage of these will be developed into more than minor oil or gas fields.

Twenty-one fields accounted for the bulk of the development drilling. These fields, the number of wells, total footage drilled, and the average depth are shown in Table 4.

Since the discovery and development of the Upper Cretaceous reservoirs at Pembina and the Mississippian reservoirs in southeastern Saskatchewan and southwestern Manitoba, the Upper Devonian sediments have been dislodged from their position as the only major reservoir rock for oil in Western Canada. The majority of the known oil and gas reserves occur in rocks of seven age groups in the following order:

Age	Recoverable Reserves of Crude Oil	% of Total Nat. Gas In Place
Devonian	48	15
Upper Cretaceous	38	6
Lower Cretaceous	5	34
Mississippian	7	27
Jurassic	2	—
Triassic	—	15
Permo-Pennsylvanian	—	3
	100	100

TABLE 1

PRODUCTION BY FIELDS
(Thousands of Barrels)

Field	Reservoir and Age of Reservoir	Crude Oil Production	Gravity of Crude °API
Alberta			
Redwater	Leduc (U. Dev.)	28,507	33-36
Leduc-Woodbend	Leduc & Nisku (U. Dev.)	20,153	35-42
Pembina	Cardium (U. Cret.)	14,765	36-38
Bonnie Glen	Leduc (U. Dev.)	7,827	35-43
Fenn-Big Valley	Nisku (U. Dev.)	7,327	30-34
Joarcam	Viking (L. Cret.)	4,793	36-38
Wizard Lake	Leduc (U. Dev.)	3,720	38
Golden Spike	Leduc (U. Dev.)	3,401	36-38
Acheson	Leduc (U. Dev.)	2,487	37-38
Turner Valley	Mississippian	2,054	37-41
Stettler	Nisku & Leduc (U. Dev.)	1,824	27-30
Westerose	Leduc (U. Dev.)	1,742	40-42
Joffre	Viking (L. Cret.)	1,690	36-40
Lloydminster	Sparky (L. Cret.)	1,222	10-14
Saskatchewan*			
Coleville	Coleville Ss. (Miss.)	1,628	10-14
Fosterton	Roseray	1,350	23
Coleville-Smiley	Viking (L. Cret.)	1,320	36
Success	Jurassic	1,150	22
Lloydminster	L. Cret.	950	8-17
Lone Rock	L. Cret.	735	12-17
Cantuar	Jurassic	721	21
Gull Lake	Jurassic	550	22
Midale	Charles (Miss.)	480	28
Dollard	U. Shaun.	313	23
Alida	Miss. Cany. (Miss.)	250	39-41
*Production estimated for December, 1955			
Manitoba			
Virden-Roselea	Mississippian	2,223	35
Daly	Mississippian	1,416	35
		113,863	

TABLE 2

DISPOSITION OF CANADIAN CRUDE

	1954 Barrels	1954 % of Total	1955 Barrels	1955 % of Total
Alberta Refineries	20,160,523	22.4	20,799,764	18.8
British Columbia	13,463,944	15.0	19,327,798	17.5
Saskatchewan	13,707,955	15.3	12,760,831	11.5
Manitoba	5,218,805	5.8	6,084,261	5.5
Ontario	34,116,343	38.0	36,325,098	32.9
U.S.A. Great Lakes	1,664,991	1.9	3,328,669	3.0
U.S.A. Puget Sound	909,053	1.0	11,364,317	10.3
Miscellaneous	514,346	0.6	551,717	0.5
	89,755,960	100	110,542,455	100

TABLE 3

DRILLING ACTIVITY IN WESTERN CANADA

	Wells 1954	Wells 1955	Footage Drilled 1954	Footage Drilled 1955	Average Depth 1954	Average Depth 1955
Alberta	1,153	1,620	5,694,759	8,415,781	4,940	5,195
Saskatchewan	807	912	2,588,810	3,235,278	3,205	3,547
Manitoba	302	361	765,032	845,435	2,535	2,342
British Columbia	34	36	149,426	207,034	4,395	5,751
Northwest Territories	6	6	20,916	12,266	3,485	2,044
Totals	2,302	2,935	9,188,943	12,715,794	3,990	4,332

TABLE 4

DEVELOPMENT DRILLING BY FIELDS

Field	Development Wells	Total Footage	Average Depth
ALBERTA			
Pembina	626	3,282,507	5,243
Joffre	135	674,260	4,994
Sturgeon Lake	33	281,437	8,528
Fenn-Big Valley	33	177,384	5,375
Sundre-Westward Ho	17	155,958	9,174
Erskine	20	108,080	5,404
Wainwright	38	85,993	2,263
Bonnie Glen	12	84,807	7,067
West Drumheller	15	83,535	5,569
SASKATCHEWAN			
Midale	49	227,505	4,642
Cantuar	69	224,912	3,259
Coleville	78	213,086	2,732
Nottingham	41	151,349	3,691
Steelman	31	149,221	4,813
Eureka	36	87,816	2,439
Battrum	28	83,530	2,983
Dollard	17	78,984	4,646
Alida	19	71,895	3,789
MANITOBA			
Roselea	175	359,789	2,056
Daly	39	96,923	2,485

TABLE 5

SASKATCHEWAN & MANITOBA DRILLING

Field or Pool	Present Areal Extent acres	Av. Pay Thickness feet	Average Depth feet	Gravity of Crude °API
Saskatchewan				
Midale	5,600	50	4,600	28
Weyburn	2,400	30	4,800	28-33
Alida	1,600	40	3,700	39
Nottingham	2,720	45	3,550	34
Hastings	800			39
Steelman	2,320			35-38
Frobisher	1,920	30-40	4,650	37
Manitoba				
Daly	7,840	63	2,000	32
North Virden and Virden-Roselea	9,320	30	1,900	34

The accumulation of oil in sands of Cretaceous age in the Athabasca "Tar Sands" area of Alberta represents the largest single accumulation of oil known to man, but because of its present uneconomic status has not been included in the above list.

Exploratory and development drilling was conducted over the entire southern half of the Western Canada Petroleum Province. However, specific areas received more exploration than others and these can be summarized into areas:

(1) West central Alberta.

(2) The Foothills belt from southern Alberta to northern British Columbia.

(3) The Peace River area of Alberta and British Columbia.

(4) Southeastern Saskatchewan and southwestern Manitoba.

(5) Southwestern Saskatchewan.

(6) Southern Alberta.

The bulk of development drilling was confined to Pembina, Joffre, southeastern and southwestern Saskatchewan and southwestern Manitoba. The developments in these fields or areas will be discussed in the following section:

Pembina (see Figure 1)—Development of the Pembina field discovered in 1953, continued at a high rate in 1955. By Jan. 1, 1956 there were 795 wells capable of producing and cumulative production had amounted to 15,676,000 barrels of 37° API crude. The field is the largest contributor to the total oil production of Western Canada. The following are a few of the pertinent factors of the Pembina field:

Reservoirs: Cardium Formation (sandstone), Belly River Formation (sandstone) and the Viking Member, Ellerslie Member and Mississippian. The Cardium is the only major reservoir and it and the Belly River Formation are the only two which are currently producing. Both are Upper Cretaceous formations.

Type of Trap: Up dip pinch-out of porosity. The Cardium sandstones wedge out in an up-dip direction.

Areal Extent: With current outpost wells the areal extent is estimated to be 507,000 acres.

Thickness of Pay: Average oil pay 18 feet.

Average porosity: 14.2%.

Average permeability: 30-50 millidarcies.

Type of drive: solution gas.

Estimated oil in place: 7,000,000,000 barrels.

Estimated recoverable oil: 1,400,000,000 barrels.

Gas-oil-ration: Averages 500-600 cf/bbl. but in some specific areas is up to 5,000 cf/bbl.

Joffre Field and Associate Areas (see Figure 2)—During 1955 development and outpost wells have extended this once minor pool until the Joffre and associated areas form a trend which may be as much as 40 miles long and one to two miles wide. The reservoir is the Viking Member (sandstone) of Lower Cretaceous age. The trap is stratigraphic, formed by lenses of porous sandstones. The porosity averages 12-13% and the permeability is in excess of 100 millidarcies. The only known reservoir energy is derived from the dissolved gas, but local small gas caps may be present. The field and the productive areas along the trend have an areal extent of some 35,000 acres. However, all of this may not be productive.

Southeastern Saskatchewan and Southwestern Manitoba (see Figure 3)—The Souris Valley area in southeastern Saskatchewan and southwestern Manitoba has been the secene of intensive exploration during 1955. A total of 18 fields have been discovered in this area, 16 of them during 1954 and 1955. In addition there are many discoveries which so far have not

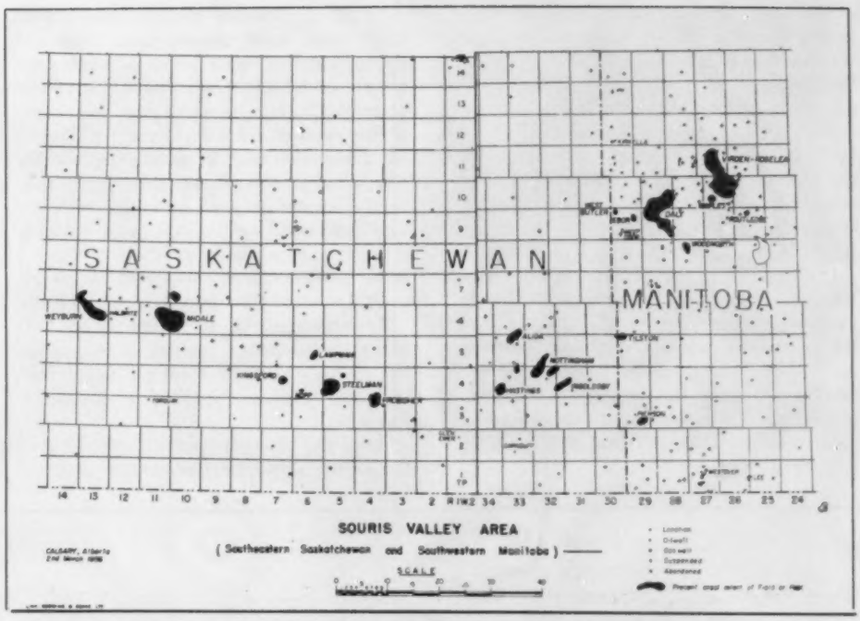


FIG. 3. *Souris Valley area showing fields and pools. All the fields in the map area except the small field in Township 14, Range 1, W2, produce from Mississippian sediments.*

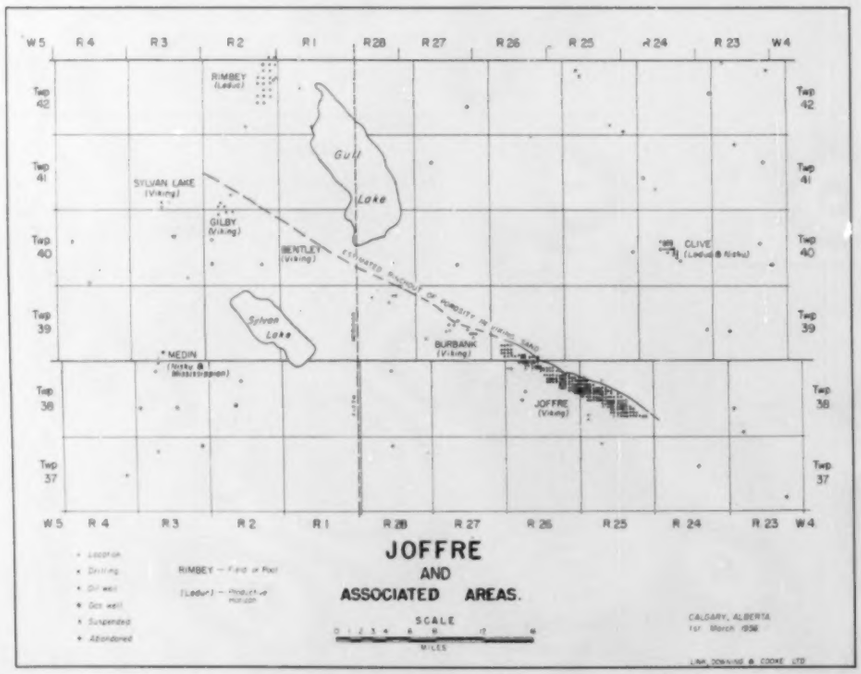


FIG. 2. *Joffre and associated areas showing oil fields and pools and trend of Viking oil pools.*

MIDALE FIELD

STRUCTURE ON TOP OF CHARLES RESERVOIR

CONTOUR INTERVAL: 20 FT.

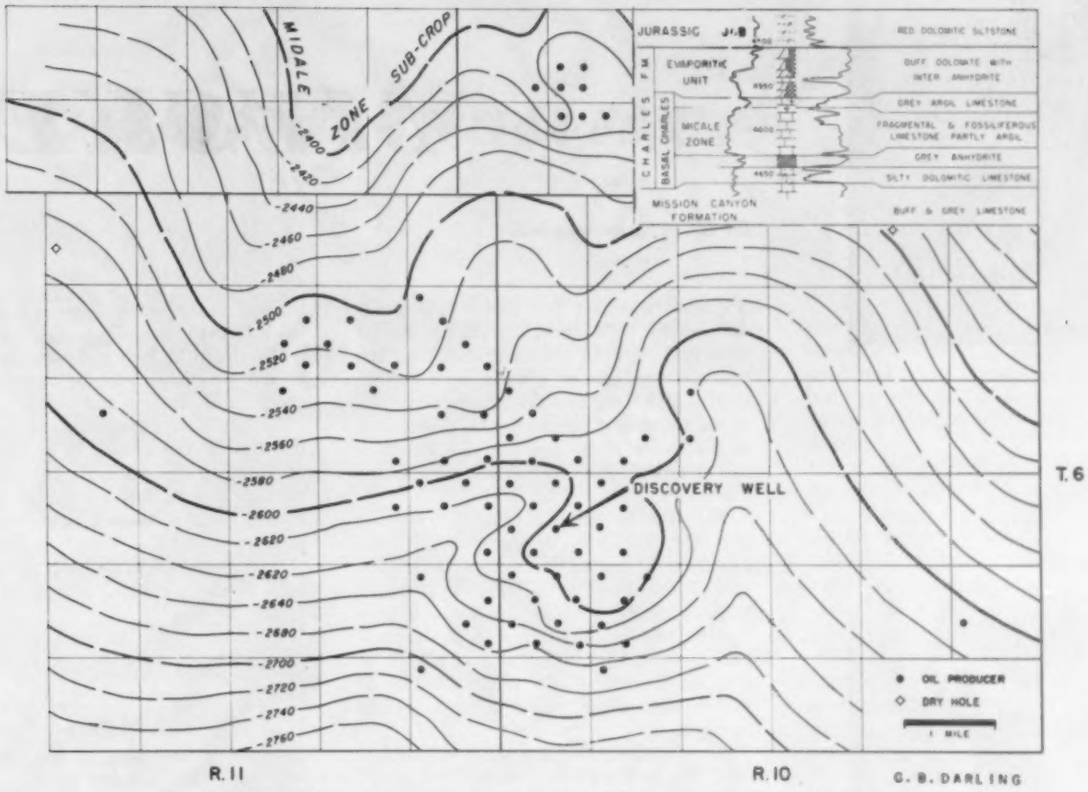


FIG. 4. *Midale Field showing structure on top of Charles (Mississippian) reservoir and type section of producing horizons. (Courtesy of G. B. Darling and staff of Imperial Oil Ltd.)*

developed into significant accumulations. The reservoirs in all the fields are the sediments of Mississippian age and consist of fragmental, oolithic, crinoidal limestones.

The Souris Valley area was on the northeast flank of the Williston Basin during Mississippian deposition. Subsequent to the deposition of the Mississippian sediments they were eroded and stripped back to their present position. The wedge edge of the Mississippian, however, is both erosional and depositional. The oil accumulations are in close proximity to and are associated with the unconformity. They are related to porosity belts and in all cases the traps are stratigraphic, although structure may be a localizing agent.

The crude in all the fields is either light gravity or light medium gravity with low sulfur content. Drilling depths vary from 1,800 to 4,500 feet and an accessible and ready market is available.

The more important of these fields, their present areal extent, depth of producing horizon, average pay thickness (as determined by Petroleum and Natural Gas Board of Saskatchewan) and the gravity of the crude are shown in Table 5.

The Midale Field is one of the largest fields developed to date and will be used to illustrate the type of oil occurrence. The field was discovered in 1953 by Shell Oil Co. and has since been developed into the largest field in the Souris Valley area. Geologically, the field is situated on the northern flank of the Williston Basin and directly down-dip from the truncated edge of the Charles Formation, the youngest Mississippian Formation in this area.

The bulk of the crude is being produced from the fragmental and oolithic limestones at the base of the Charles Formation, but some production is realized from the underlying Mission Canyon Formation.

The structure on top of the Charles reservoir is shown on Figure 4, together with the type section. Structure is limited to a slight southward trending nose. Farther up-dip (see Figure 4) the reservoir rock has been eroded by post Mississippian erosion and during the erosional period alteration of the exposed sediments occurred which resulted in anhydrite infilling and dolomitization. This, together with the overlying Jurassic red beds forms an effective stratigraphic trap.

The field limits have not been defined in any direction and the Weyburn and Midale Fields may eventually be joined by development and step-out wells. Some reservoir data has been released by the Petroleum and Natural Gas Conservation Board of Saskatchewan and these are:

Average depth of reservoir	— 4,600 feet.
Average porosity	— 10.6%
Average pay thickness	— 50 feet
Average connate water content, % of pore volume	— 50%
Average permeability	— Varies from 5 md. to 500 md.
Gas-oil ratio	— Low
Average M.P.R./well	— 100 b/d
Reservoir Energy	— Gas solution drive with possibly some effective bottom water.
Crude Oil Analysis:	
Shrinkage factor	— 0.80
API Gravity	— 27.5°
Pour Point °F.	— 40
Sulfur %	— 2.6
Distillation recovery at 550° F	— 60%
Saybolt viscosity at 77° F	— 95
Saybolt viscosity at 100° F	— 86

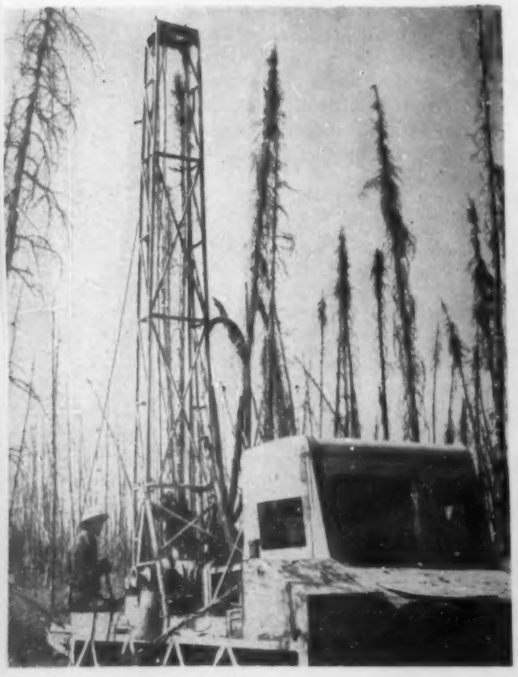
Surveyor surveying in line with transit. Note shooters loading hole in background. All photos used in this article are through the courtesy of Ken Liddel of the Calgary Herald and Rick Ferrel of Century Geophysical Corp. of Canada.

MUSKEG

By Ben F. Rummerfield*

Drill unit pulling survey unit out of muskeg in a burned off area.

Drill set up drilling a shot hole.



DURING the past two years exploration activity in Western Canada has tended toward a greater concentration in the northwestern part of Alberta, northeastern British Columbia and the southern portion of the Northwest Territory. Gas discoveries in the Peace River and the rich Pembina and Sturgeon Lake fields have stimulated this trend.

The area in which activity is centering presents difficulties to the geologist, the geophysicist and to the driller. In winter, special equipment is required or standard must be carefully winterized if it is to give service. Personnel requires special protection. In summer the ingenuity of personnel is taxed because of the unstable nature of the muskeg which covers a large portion of the area.

Muskeg in summer is a soupy mixture of mud, decayed vegetable matter and moisture. Vegetation on the surface is not sufficient to add stability. Wags who have worked in the muskeg report that it is too thick to swim in and too thin to walk on.

Movement of men and equipment in the area is complicated by the large number of unabridged streams and lakes.

Geophysicial reconnaissance parties are the first on the ground in any area where oil is sought and hence do not have the advantage of log roads and bridges which the drilling and producing departments later must construct if drilling is undertaken.

A seismic crew in Canada, when working on a 30-day schedule, consists of approximately 30 men.

A rotation plan is used whereby each man works 20 days, then is relieved for 10 days.

Crew operations are often in a very remote area many miles from the nearest town. It is necessary to provide lodging, food and other supplies for the personnel, and for this purpose a camp is established. The crew camp is, in reality, a self-sustaining small community. Communications are often established by a radio-telephone combination. Often crews are isolated for

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* *Executive vice president, Century Geophysical Corp.*

Shooters putting on insect repellent. Is a tan worth the bites?

Note ground condition. Much of area considerably worse than this.

reconnaissance

fairly long periods of time, particularly during severe weather.

Metal trailers are provided as living quarters for the men while working on a prospect. Each bunk trailer accommodates eight men. A trailer fully equipped for cooking is provided for the cooks who prepare generous meals of various menus. There are shower trailers, an office trailer, and power plants to furnish electricity for the camp.

Seismic crews operate during the entire year. The weather in Canada presents a problem in winter and in summer. The temperature often drops to as low as 40 to 50 degrees below zero over periods of weeks and sometimes months. Adequate clothing is a "must." In summer the crew is faced with flies, mosquitos, and other insects as well as swamp conditions.

In addition to the weather, the terrain presents problems. For example, transportation of men and equipment in muskeg country is extremely difficult. There is no pavement, no roads, rarely trails, and special machinery is necessary to clear a way for other equipment. Bulldozers are used in the bush country to clear lines and to build roads and passes. As many as eight cats may be used in conjunction with one crew. Usually the cats are used during winter months when the ground and muskeg is frozen.

A crew of men walking and using portable power saws is sometimes used in summer to clear traverse lines in the "bush." In these same areas (such as the area shown in the accompanying photograph) it is impossible to work cats in the summer as there is no bottom to the ground where it is not frozen. Century Geophysical has pioneered in the field of special equipment for this purpose, and was one of the first operators of bombardiers in oil exploration in 1947.

The bombardier, or "Snowmobile," type of equipment has been converted and adapted for geophysical work. Personnel carriers, surveying equipment and shooting and recording instruments, as well as the heavier drills and augers used to drill shot holes, have been mounted on bombardiers.

Each crew has approximately 10 units of this special equipment in addition to its standard geophysical equipment. The first units had a ski arrangement on the front, but this did not prove to be satisfactory and at present the equipment is all track driven.

The mechanics employed, together with the field personnel, on each crew work at night to repair and maintain the vehicles so the equipment is always in good mechanical condition for operations.

Considering all items which a crew must have, such as camp trailers, special transportation equipment, seismic instruments, office equipment and personnel, each crew represents a capital expenditure of approximately $150,000. It costs about $40,000 per month for the operation of each crew, including camp supplies, food, dynamite, drilling supplies, etc.

ACKNOWLEDGEMENT

Photographs with this article are published through courtesy of Ken Liddel of the Calgary *Herald* and Rick Ferrell of Century Geophysical Corp. of Canada.

Helper laying out geophones. Note long spikes on geophones to give better contact with the ground.

Units leaving for the field.

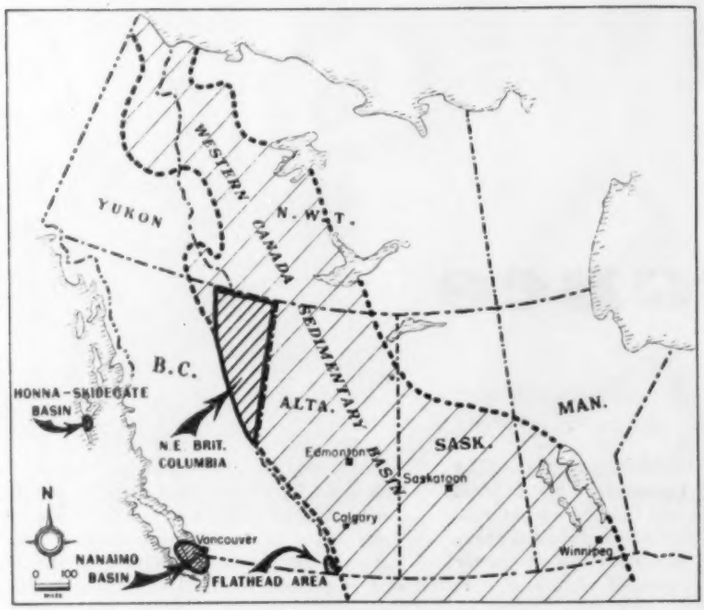


FIG. 1. *Index map showing the four areas discussed with regard to petroleum and natural gas.*

The search for natural gas in northeastern British Columbia has developed more than two trillion cubic feet. Several important oil shows have been found, but no commercial oil fields.

PETROLEUM AND NATURAL GAS IN BRITISH COLUMBIA

By C. E. Cleveland[1]

IN DISCUSSING the petroleum and natural gas resources of British Columbia, it must be realized that exploration for oil and gas in this province has never been on a large scale because of the limitations imposed by its geology and because, until very recent years, the most geologically favorable part has been comparatively isolated.

British Columbia is, to a large measure, underlain by igneous rocks which include great batholithic bodies of granite and their satellites as well as widespread bodies of volcanic material. Areas containing metamorphic rocks and highly disturbed rocks of pre-Cambrian age and younger supplement this unfavorable condition so that relatively few areas remain in which there are thick sections of marine strata providing a suitable habitat for petroleum and natural gas. Probably less than 30% of the Province's area is in this favorable category, a large portion of which lies in the triangular shaped area of northeastern British Columbia, eastward from the Rocky Mountains to the Alberta boundary.

[1] *Senior Geologist, Pacific Petroleums Ltd. This article is an abridgement of a paper under the same title presented by Mr. Cleveland before the Northwestern Regional Conference of the American Institute of Mining and Metallurgical Engineers, Seattle, Wash., May 3-5.*

In addition to northeast British Columbia with which we shall be chiefly concerned in this paper, it might be appropriate at this time to mention three other areas in the province with regard to petroleum and natural gas. (*Figure 1*) These areas are herein termed (1) Nanaimo Basin; (2) Honna-Skidegate Basin; and (3) Flathead Area.

The Nanaimo basin is situated on the east side of Vancouver Island and extends into the Straits of Georgia. (*Figure 2*) The basin is about 80 miles long with a maximum width of 25 miles. The sedimentary fill consists of sandstones and shales of Upper Cretaceous age and its estimated thickness ranges from 7,600 feet in the Nanaimo area to over 10,000 feet at the southeast end of the basin. Commercial coal beds are also present in the sedimentary section. For the most part the sandstones and shales are non-marine but some marine shales are present. Basal beds of the fill rest on an eroded floor of lavas, and altered sedimentary rocks of Permo-Pennsylvanian and Triassic age. In places the relief on this basement is as much as 400 feet.

Faults are present along the west side of the Nanaimo basin and they are believed to be part of a major fault zone which extends for at least 70 or 80 miles along the east coast of Vancouver Island. Folds are also present. They strike northwesterly, roughly parallel to the trend of the basin, and may be seen at the surface on some of the Gulf Islands in the Straits of Georgia. Faults are also reported to be present on some of the Islands.

Marine shales are known near the western edge of the Nanaimo basin and the thickening of the sedimentary section to the east under the Straits of Georgia suggests the possibility of additional marine strata in that direction. The presence of stratigraphic traps caused by inter-fingering of marine and non-marine sediments is therefore a possibility. Providing source beds are present in the deeper part of the basin, the migration and entrapment of oil or gas towards the margins of this basin might be expected. No oil or gas seeps are known within the Nanaimo basin, although gas seeps have been reported on the northeast side of the basin in Tertiary rocks near Vancouver.

The Honna-Skidegate basin occupies the central part of the south end of Graham Island and extends a short distance southward across Skidegate Inlet into the north end of Moresby Island. (*Figure 3*) The overall length of the basin is about 14 miles and the maximum width about 10 miles.

Courtney E. Cleveland received his Ph.D. degree in geology from McGill University, Montreal in 1941. He joined the staff of Barnsdall Oil Co. in Calgary, Alberta in 1949. He is presently senior geologist of Pacific Petroleums Ltd.

The sedimentary fill has a maximum thickness of more than 7,000 feet and is composed essentially of non-marine sediments which rest in some places on a basement of highly folded igneous and metamorphic rocks. The sediments are sandstones, conglomerates and shales, and they range in age through Cretaceous to Tertiary. Coal is found in the basal part of the Lower Cretaceous. The Tertiary sediments are present at least along the margins of the basin. Tertiary igneous rock intrude the basin sediments as dykes and sills; in other places these igneous rocks cap the sediments as basaltic flows.

The sedimentary beds of this basin have been folded and faulted. The north and western edge of the basin contains strata which are severely folded, overturned and faulted.

There are no promising manifestations of oil or gas in the Honna-Skidegate basin. One or more small gas seeps and oil seeps have been reported from the north side of Skidegate Inlet. Tarry oil is present in places in amygdules and cracks of the Tertiary basalt flows and in intrusive dykes. Bituminous argillites in the basal rocks of the basin are considered as the source of the tarry oil. Some oil staining is present in limestones in the basal rocks.

In the southeast corner of British Columbia, there is an area of pre-Cambrian strata extending from the east side of the Flathead Valley to the Waterton Lakes in Alberta. (*Figure 4*) This area of pre-Cambrian rocks also extends northward from the International Boundary for about 35 miles and southeastward into the United States for about 60 miles and forms the Clarke Range of the Rocky Mountains. The pre-Cambrian rocks constitute a great thrust sheet which has over-ridden Paleozoic and Mesozoic beds. The pre-Cambrian beds of this thrust sheet form a large open syncline. On the west limb of this syncline there is an anticlinal fold in the pre-Cambrian beds terminated on the east side of the Flathead Valley by a normal fault. This fold persists in depth, with the result that the large thrust fault at the base of the thrust sheet is arched as well as the underlying Paleozoic beds beneath it. There are oil and gas seeps in the vicinity of the anticlinal folding and the source of the oil and gas is undoubtedly in the underlying Paleozoic beds beneath the pre-Cambrian strata. The Flathead area, therefore, may be considered as potentially favorable for the discovery of oil and gas.

Although the areas discussed in the first part of this paper show some evidence of the presence of petroleum and natural gas, they are not of sufficient account to pursue further at this time. Rather, we shall direct our attention to northeast British Columbia where there are rapidly increasing proven reserves of natural gas which must be added to the province's list of important natural resources. Some oil has been found in northeastern British Columbia but exploration work to date has not proved of sufficient quantities to discuss this potentially important resource in terms of reserves.

The petroleum and natural gas resources of northeastern British Columbia discussed in this paper are contained within a triangular shaped area of approximately 34,-200 square miles. (*Figure 5*) It is bounded on the north by the Northwest Territories, on the east by the Province of Alberta, and on the west by the Rocky Mountain foothills. Physiographically the area belongs to the western border of the Interior Plains. The town of Dawson Creek is near the south end of the area and Ft. Nelson on the Alaska Highway about 80 miles from the north end. The major gas discoveries to date have been made within a radius of 100 miles of the town of Fort St. John on the Alaska Highway, 45 miles northwest of Dawson Creek.

A part of the Western Canada Sedimentary Basin extends through northeastern British Columbia (*Figure 1*), where the total sedimentary fill is approximately 6,000 feet thick in the northeastern corner of the Province and probably over 20,000 feet thick to the southwest at some places along the foothills of the Rocky Mountains. This pronounced thickening to the southwest is the combined result of deposition and northeastward truncation of beds by erosional unconformities.

The complete succession of sedimentary rocks present includes strata of Upper and Lower Cretaceous, Jurassic, Triassic, Permo-Pennsylvanian, Mississippian, Upper and Middle Devonian and Cambrian (?) age. These strata lie upon a basement of pre-Cambrian rocks, presumably granitic

FIG. 3. *Location of Honna-Skidegate sedimentary basin.*

in composition. *Figure 6* shows that portion of the sedimentary section which has been penetrated by drilling in the Fort St. John area.

Beds of the Upper Cretaceous are widely distributed and outcrop in many parts of the area. The Upper Cretaceous section is thin compared with the Lower Cretaceous and consists of marine shales and deltaic sandstones.

Lower Cretaceous beds form a thick section of both marine and non-marine strata and underlie the whole area. The basal part of the Lower Cretaceous is composed of sandstones and conglomerates of non-marine origin, whereas the upper part is a thick section of shales and sandstones of marine origin.

The combined thickness of Upper and Lower Cretaceous beds ranges from a few hundred feet at the northeast corner of the Province to more than 6,000 feet at the edge of the foothills southwest of Dawson Creek.

Jurassic sediments are not widespread in the subsurface of the area under discussion in northeastern British Columbia. They are confined to the southern part of the region and close to the foothills near Hudson Hope they form a section of marine sandsones and shales about 1,200 feet thick. In the

Drilling a seismic "shot hole." The drilling rig is mounted on a weasel, for travel through brush and over muskeg.

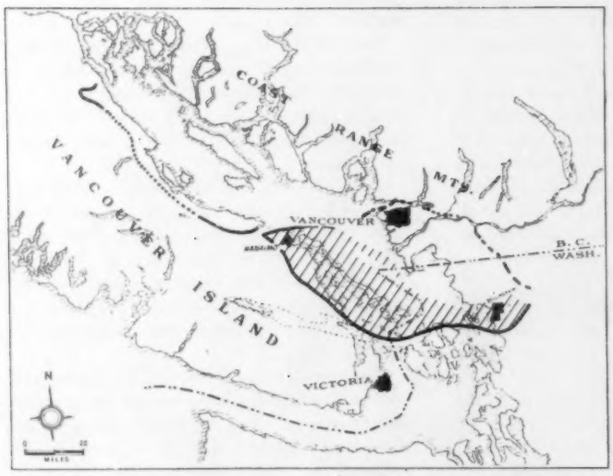


FIG. 2. *Location of Nanaimo sedimentary basin.*

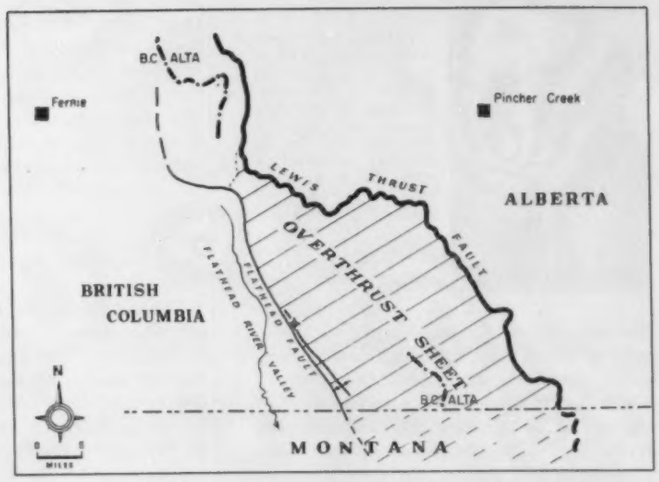


FIG. 4. *Flathead area showing Precambrian overthrust sheet.*

Fort St. John area, the Jurassic is only about 500 feet thick and there is continued thinning to the north and northeast from this point. The basal beds of the Jurassic are calcareous petroliferous shales which are overlain by silty shales and quartz sandstones of marine origin. Much of the Jurassic in northeastern British Columbia has been removed by erosion, as indicated by the unconformity separating Jurassic and Cretaceous beds.

Triassic beds are present in the subsurface, at least over the southern half of the region, and appear in outcrops along the foothills belt as far north as the boundary of the province. An unconformity separates these beds from the Jurassic. Erosion and deposition have thinned the Triassic from 3,400 feet in the Hudson Hope area to less than 600 feet at the Alberta boundary 100 miles to the northeast. The lower part of the Triassic consists of silty to sandy marine shales. The upper part of the Triassic is a succession of anhydritic shales, fine grained sandstones, limestones, dolomites and some red beds.

Beds considered as Permo-Pennsylvanian in age underlie the southerly part of the region. The beds are composed of limestone, dolomite and cherty sandstones. Where well-defined, the maximum known thickness of the Permo-Pennsylvanian is about 500 feet. An erosional unconformity truncates the top of the Permo-Pennsylvanian beds and thus has influenced their present distribution.

There is a thick succession of Mississippian beds in northeastern British Columbia. The Upper Mississippian is composed principally of carbonate beds in the upper portion and clastic beds in the basal portion. There is a wide range in the thickness of the Upper Mississippian, due probably to faulting, although in some places the relationship of the Mississippian beds to the overlying Permo-Pennsylvanian is not fully understood. The Upper Mississippian is underlain by a thick succession of cherty limestones, followed at the base by calcareous shales and impure limestones.

Little is known at the present time about the subsurface of the Devonian and deeper beds. Regional geology, based on information from a few deep wells, indicates that there are thick successions of limestone and shale together with some sandstone. Reef rocks may be present. Devonian beds probably underlie the whole of northeastern British Columbia.

The sedimentary beds of northeastern British Columbia contain structural folds and in many cases the gas accumulations are related to these folds. In areas well removed from the foothills the folds are gentle and not always parallel to the Rocky Mountain front. Westward, close to the foothills, the folds are defined more sharply and in general parallel the mountain front. Many of the folds cannot be assigned to one geologic age inasmuch as some of them bear evidence of recurrent deformation over several geological periods. The oldest folds were probably formed in mid-Paleozoic time, the youngest in Tertiary time.

Faults of more than one age displace the rocks of northeastern British Columbia and in places may play an important part as traps for gas or oil. Among the youngest faults are the thrust faults of the foothills. Older faults are known in some places east of the foothills where wells have penetrated the deep subsurface.

Exploration work to date has found 11 gas fields and 15 gas-bearing areas. These are shown in *Figure 5*. Many of the gas-bearing areas will undoubtedly become fields with further development. These fields and areas account for a total of 10 major gas-bearing zones and numerous minor zones in a stratigraphic interval of 10,000 feet, extending from the Lower Cretaceous to Devonian.

The following remarks indicate the distribution of the gas zones and their relative importance from a reserve standpoint (see *Figure 6*):

Upper Cretaceous—There are no gas zones of commercial importance in beds of the Upper Cretaceous in northeastern British Columbia.

Lower Cretaceous—Some of the continental beds in the basal part of the Lower Cretaceous contain appreciable quantities of gas. The gas zones are in conglomerates and sandstones which are well-developed in the region about Fort St. John, but these beds do not extend as far north as the central part of northeastern British Columbia. (Cadomen and Gething formation; Bluesky member)

Marine sandstones and shales occupy the upper part of the Lower Cretaceous. The sands do not extend far north of the Fort St. John area and are well-defined to the south, southwest and southeast. Near the top of the Lower Cretaceous there is a sand which contains important gas zones in the Sunrise, Pouce Coupe and South Pouce Coupe areas south and east of Fort St. John. (Peace River formation—Cadotte member)

Jurassic—Gas Reserves in beds of Jurassic age compare in volume with those assigned to the Permo-Pennsylvanian mentioned below. The gas zones are in quartz sands of excellent porosity and permeability and in some places the sands and contained zones are very thick. These sands rest upon marine shales and are noticeably well-developed in the Buick Creek area. (Nekanassin formation) Jurassic beds in the subsurface do not extend much farther north than the Buick Creek area and they thicken to the west and southwest.

Triassic—Gas zones in the upper part of the Triassic account for the largest portion of the known reserves and amount to almost 50% of the total gas reserves of the region. They are present in the Fort St. John area and other adjacent areas in the southern part of northeastern British Columbia. The most important gas zones are in fossiliferous limestone and dolomite beds near the top of the Triassic and in a thick widespread sandstone formation close to the base of the Upper Triassic. In addition, there are appreciable volumes of gas in "stray zones" of sand and dolomite in the

middle part of the Upper Triassic. The above zones are referred to in the Ft. St. John area as Triassic A, B, C and D. (see *Figure 6.*)

Because of the erosional unconformity at the top of the Triassic, productive zones of the Triassic are probably absent over much of the northern two-thirds of northeastern British Columbia east of the foothills.

Permo-Pennsylvanian — Although relatively thin where explored, the Permo-Pennsylvanian contains the second largest portion of the gas reserves in northeastern British Columbia, accounting for 22% of the known reserves of the region. Gas-filled porous zones and fracture zones separated by dense zones are present in limestones, dolomites and some of the cherty sands of the Permo-Pennsylvanian. Although the true relationship of the Permo-Pennsylvanian to underlying Mississippian beds is not fully understood, the Permo-Pennsylvanian is probably absent over most of the region northeast of the Fort St. John area. However the Permo-Pennsylvanian thickens appreciably westward and southwestward towards the foothills, where additional gas zones may be present.

Mississippian and Devonian—Despite the limited amount of drilling undertaken in Mississippian and Devonian beds, some gas zones have been found. No doubt a considerable amount of additional exploration drilling will be undertaken in Mississippian and Devonian beds in northeastern British Columbia east of the foothills because these beds are widesperad in the subsurface and may offer good opportunities for discovery of additional gas zones.

Statistics of the Gas Reserves of Northeastern British Columbia—At the end of October, 1954, Ralph Davis, consulting engineer of Houston, Texas, completed an estimate of the gas reserves in northeastern British Columbia. This estimate was used before the Federal Power Commission, Washington, D. C. The reserves are adequate to meet the Canadian markets and the gas committed for sale to the United States for more than 20 years.

Mr. Davis estimated that the Fort St. John area contained 1.26 trillion cubic feet of original gas in place, that is 1.055 trillion cubic feet of recoverable gas, or 975 billion cubic feet of pipeline gas. He also estimated that remaining areas in northeastern British Columbia contained 801 billion cubic feet of original gas in place, that is 677 billion cubic feet of recoverable gas, or 627 billion cubic feet of pipeline gas. The total reserve therefore, estimated by Mr. Davis for northeastern British Columbia as of October, 1954, is 2.06 trillion cubic feet of original gas in place, that is, 1.73 trillion cubic feet of recoverable gas, or 1.60 trillion cubic feet of pipeline gas.

A number of additional gas discoveries have been made in northeastern British Columbia since that time, but figures are not available for the additional gas reserves proven thereby.

Although the composition of British Columbia gases has a considerable range from place to place, in general, for each one million cubic feet of pipeline gas produced there may be produced 15 to 50 barrels of liquid products and 0 to 5 tons of elemental sulfur depending on the composition of the gas.

The foregoing discussion of the geology and the distribution of the gas zones of northeastern British Columbia, together with the statistics given regarding reserves and the location of the present gas fields, demonstrates that large additional reserves of natural gas are undoubtedly present in northeastern British Columbia.

Exploratory drilling undertaken to date suggests that many of the sedimentary formations which have produced gas in the southern part of the region will provide additional large reserves. In addition, the widespread Mississippian and Devonian beds present in the central and northern parts of the area may contribute appreciable reserves as exploration proceeds in that direction.

The foothills and other unexplored areas of northeastern British Columbia lying westward from the Interior Plains may contain large additional gas reserves. However, active exploration programs in these areas are required before any sound reserve prediction can be made.

No oil fields have been developed in northeastern British Columbia. Several important oil "shows" have been found in wells drilled for natural gas and two oil wells have been completed near the Alberta Boundary. The oil "shows" have been found in conglomerate and sandstone of Lower Cretaceous age; sandstone of Jurassic age; sandstones, limestones and dolomites of Triassic age; and dolomites of Permo-Pennsylvanian age. In many cases, large volumes of gas accompany the oil "shows." Very few wells have penetrated the Devonian beds of northeastern British Columbia and the possible presence of oil-

(Continued on page 152)

FIG. 5. *Northeast British Columbia showing distribution of gas producing areas.*

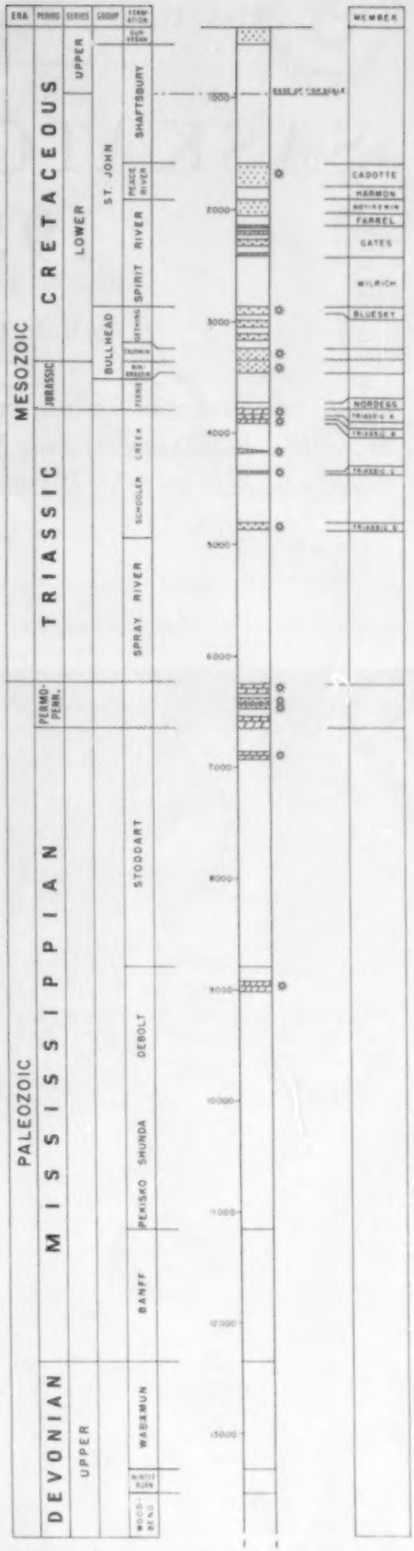


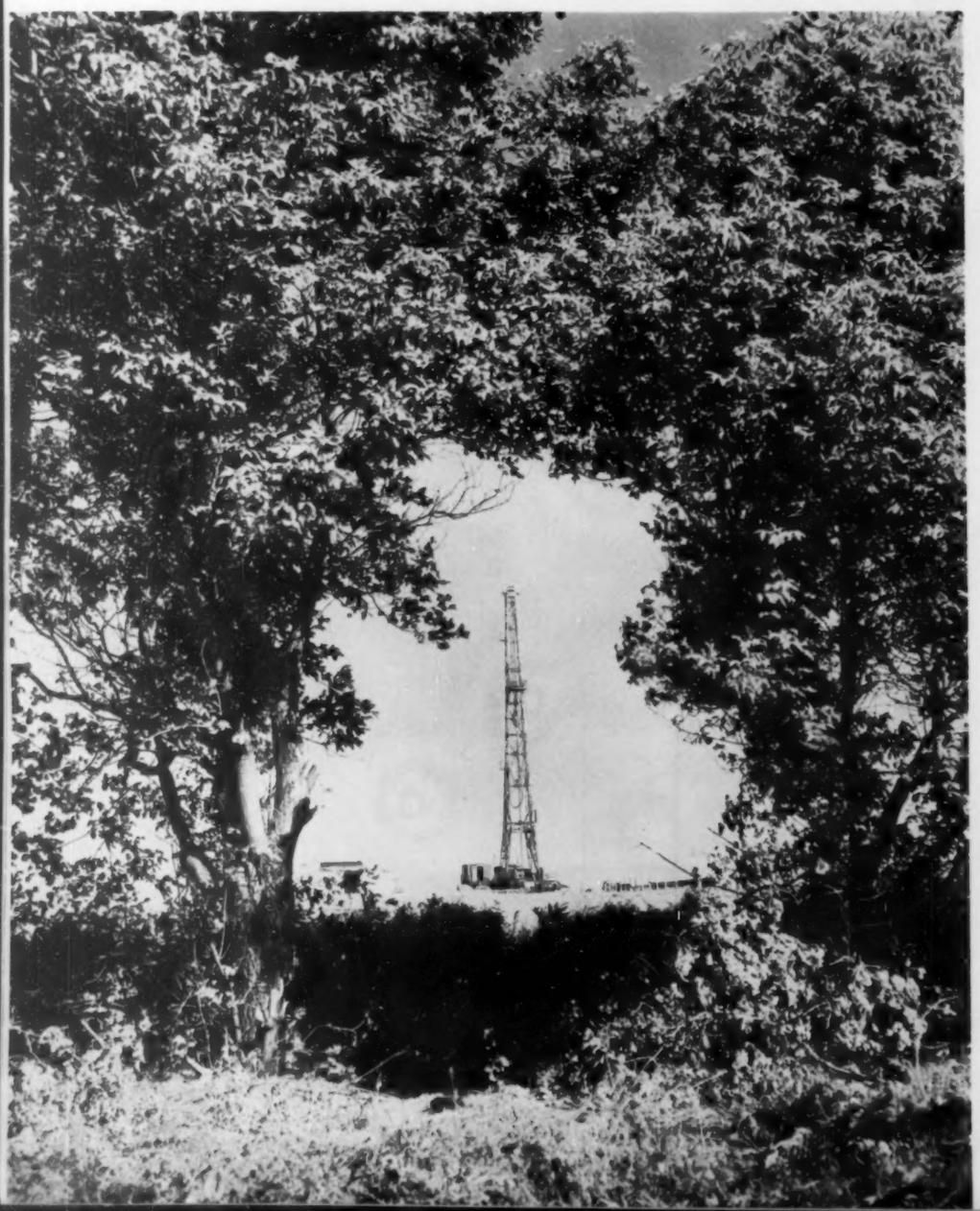
FIG. 6. *Columnar section showing gas bearing zones Fort St. John area, British Columbia.*

SASKATCHEWAN, 1955

By R. R. McDaniel

Crude production in Saskatchewan doubled in 1955 reaching more than 40,000 barrels daily by the end of the year. Discovery of new light oil fields has stimulated drilling to a new high.

A Shell drilling rig at work in the Midale oilfield of Southern Saskatchewan. (Photo courtesy of Shell Oil Co. of Canada.)



SASKATCHEWAN, long regarded as primarily a medium and heavy gravity oil region, now holds promise of being a major producer of light crudes. During the latter part of 1954 and the early part of 1955 a number of highly indicative light crude discoveries were made in the southeastern portion of the Province. These discoveries were proven during 1955 to be of major significance. Fields such as Alida and Nottingham have rapidly developed into medium-sized prolific oil reservoirs. The Steelman area, among others, may prove to be a major field. The rate of new discoveries is continuing at a very rapid pace.

Westspur Pipeline Company has been granted a permit to construct an oil pipeline and gathering system throughout the area. Construction has been delayed by severe winter conditions, however, it is hoped to be completed early in the summer of 1956. From the high discovery rate and the rapid development of pipeline facilities it is evident that this segment of the greater Williston Basin is now one of the most prospective areas in Western Canada. It is apparent that at least a portion of the long sought Williston Basin oil reserves are now being found.

The other areas of Saskatchewan have also been very active during the past year. There has been considerable development in the Cantuar-Fosterton area and particularly in the Cantuar field itself. Drilling is also being continued in the Coleville heavy crude field. In this latter area the Coleville-Smiley gas field has been unitized and placed on steady production into the Saskatoon area gas distributing system.

Drilling and production have reached new highs during 1955 in Saskatchewan. Based on the published statistics of the first ten months it is apparent that close to 1,000 wells will have been drilled in the Province during 1955. Production for the first time has exceeded 1,000,000 barrels per month and during the latter part of the year has risen to over 40,000 barrels per day. The average rate is double that of 1954. It is forecast that these rapid increases will continue for at least the next two years. It is readily apparent that Saskatchewan will soon be a large net exporter of crude. The most important feature in these gains is the increasing percentage of light gravity crudes. During 1954 less than a million barrels of light crude were produced while during the first ten months of 1955 light crude production was well over two million barrels.

The Midale-Alida area will no doubt be the source of much greater increases in light crude production. The importance of this area can be readily seen by the high discovery rate, particularly in the last year and one-half. (See map.) This general area of Saskatchewan is situated on the northeast flank of the Williston Basin. The main oil producing horizons are in the Charles and Mission Canyon formations of Mississipian age. These zones have been found to be productive at depths generally ranging from 3,000 to 5,000 feet. As a result,

both exploratory and development drilling can be carried out at a rapid pace.

Gravity of the crude varies from medium to light. The medium crudes such as found in the Midale field, have a relatively high sulfur content. As a result, some difficulty has been, and probably will be, experienced in marketing this oil. The light crudes have been found to have a much lower sulfur content and are readily marketable. It is intersting to note that this area is much closer to the eastern crude markets and, therefore, it has a somewhat preferential position.

Confidence in the area was displayed as early as last summer by the fact that the Westspur Pipeline Company applied for, and received, permission from the Board of Transport Commissioners to build a large trunk line and gathering system throughout the area. It is proposed that a 12-inch trunk line be built from Interprovincial Pipe Line Company's pump station at Cromer, Manitoba to the Midale field with gathering systems for the fields along the route. (See map.) Although the construction of this line has been halted by winter conditions it is expected to be completed during the early summer of 1956. Once this line is in operation it will greatly facilitate the movement of crude from this area.

As was previously stated, the Charles and Mission Canyon zones are the principal producing horizons in this area. The Charles member is found directly above the Mission Canyon and the two are usually separated by a dense zone. These horizons truncate in a northeasterly direction and have been eroded so that the two formations subcrop. Both zones are primarily composed of carbonates with some shale breaks and anhydrite infilling.

The pay section of the Charles is generally found in the lower portions of this member. The porosity is usually of a fine intercrystalline or granular type. As a result, the permeability is usually quite low. There appears to be considerable variation in the porosity development throughout the area hence it is believed that the oil accumulations are mostly of a stratigraphic type.

The Mission Canyon member is generally found to be a thick, porous and permeable zone. As a result, it is believed to have good continuity throughout the area except, possibly, where severe erosion has occurred in the more northerly sectors. A huge aquifer is indicated which will probably provide good water drives in most of these fields. The porosity development is generally of a well developed granular nature with some vuggy material also evident. The uppermost portions of the zone are often found to be tight. This condition may be quite erratic and, therefore, it is difficult to predict the top of the effective porosity in many of the reservoirs. In most cases the oil accumulations appear to be in erosional type features. The reasons for the entrapment of this oil appear to be very complex. In the majority of cases sloping water tables are evident and although structural closure may not exist, an oil accumulation is found. As a result, the fields, some of which appear to be very prolific, are of an unusual nature.

R. R. McDaniel, consulting engineer, Calgary, is a native of Canada who has been engaged in oil engineering since his graduation from the University of Oklahoma in 1947. He spent two years with Creole Petroleum Corp. at Maracaibo, Venezuela, before being transferred to the Imperial Oil Ltd. staff at Calgary where he was division reservoir engineer before his resignation to enter the consulting field.

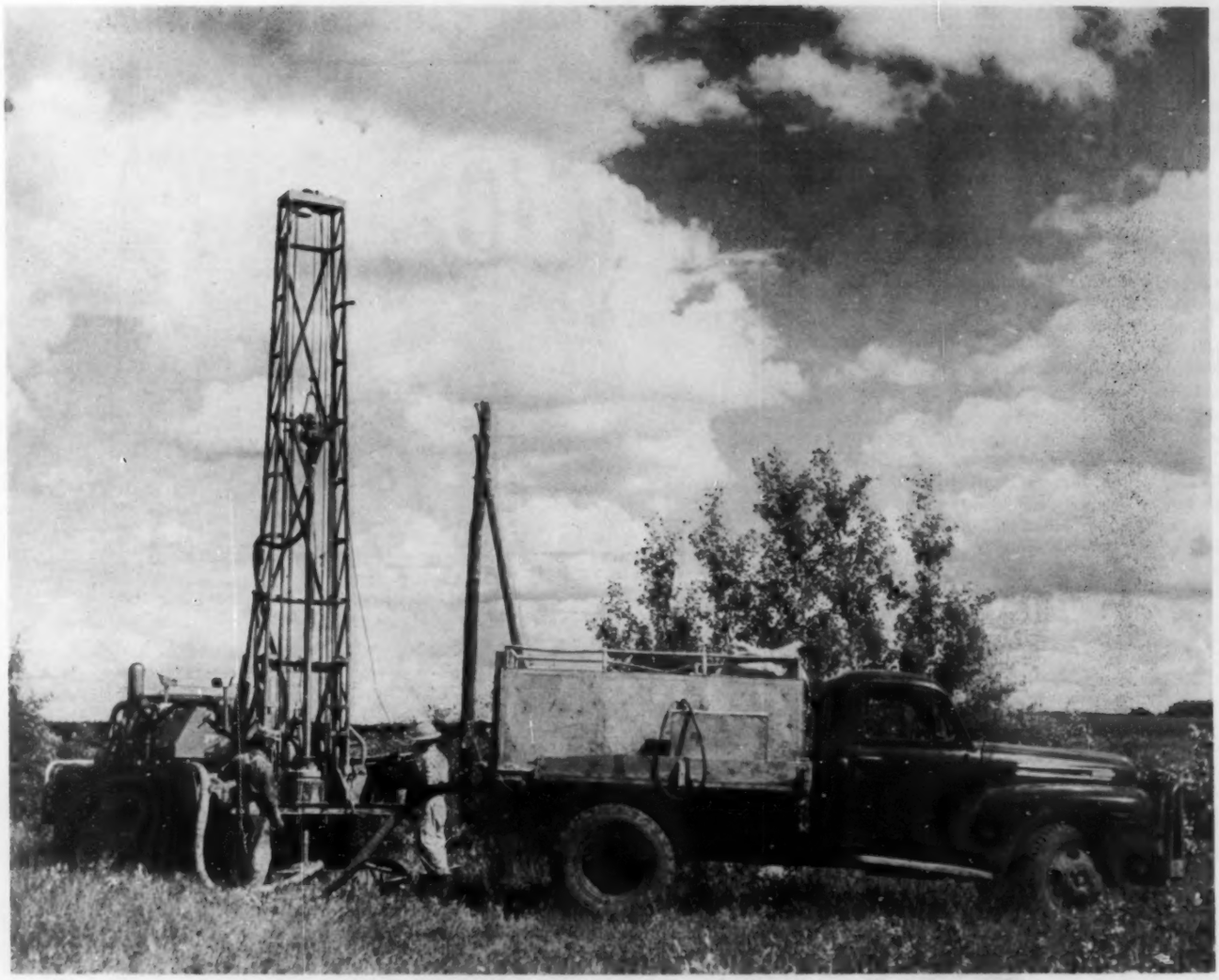
The dashed line shows the route of the Westspur Pipeline under construction scheduled for completion this summer.

The Charles zone reservoirs are also found to have some unusual characteristics. In the Midale field, for example, nearly all of the wells, regardless of structural position, produce some water. This condition is further complicated by the fact that some close-by up-dip wells were found to be completely water bearing. It may also be found that drillstem test data is not entirely reliable in either zone and particularly in the Mission Canyon member. On a number of occasions relatively clean oil recoveries have been obtained yet when placed on production the wells have produced essentially all water. A number of wildcat wells have obtained such shows only to be finally abandoned. Such conditions relate the tricky and uncertain nature of this area. It should be pointed out, however, that a number of apparently prolific fields such as Alida, Nottingham and Steelman have nevertheless been found. These facts may prompt optimism and yet be discouraging. It is believed this is an area where patience will be more than a virtue.

The fields are all in the initial phases of production and, therefore, there is only limited knowledge of the reservoir characteristics. Much of this pertinent reservoir data has not been released. As a result, it is difficult to obtain accurate volumetric and recoverable reserve estimates. The estimation of recovery efficiencies is probably the most critical problem. The reservoirs in both zones are often found to have an unusually thick oil-water transition zone. A sloping oil-water contact is also evident in at least several of the Mission Canyon zone fields. The effect that such conditions may have on ultimate recoveries is presently not fully understood. It is, therefore, believed that this factor should be given careful consideration in arriving at reserve estimates for these fields.

In view of the importance of this area some of the presently more important fields have been individually discussed hereafter. Some of the general information on these same fields is shown on Table No. 1.

Weyburn Field. The Weyburn or Ralph oil field is located at the westerly edge of this general area as may be noted in the map. Production is obtained from the Charles zone. There does not appear to be any definite continuity of the oil-water contact and, therefore, it is believed that the oil accumulation is primarily the result of stratigraphic conditions. As a result of these characteristics it is difficult to estimate the area extent. An average pay zone thickness of 28 feet has been reported by the operators for the existing wells. The porosity is of an intercrystalline or granular nature and is reported to average around 14 percent. A high connate water content, probably in the neighborhood of 50 percent, is indicated. The majority of the wells have produced with relatively high water cuts since completion. It is interesting to note, however, that this water



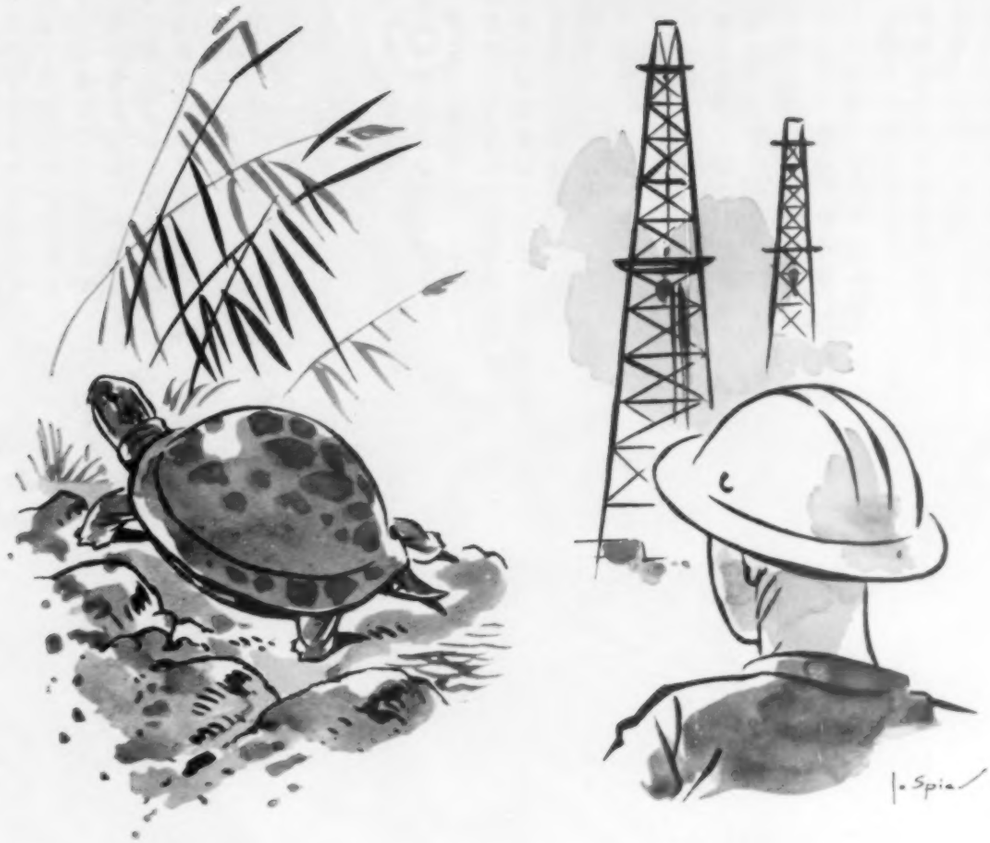
An Imperial Oil portable seismic drilling rig in the Kamsack, Saskatchewan, area drilling shot holes for dynamite charges placed and exploded by seismic crews following this operation. (Photo courtesy of Imperial Oil Limited.)

production has not increased appreciably with production. The volumes of oil in place have been estimated, on the basis of the figures given, to average around 1,000,000 barrels per 80-acre well. It, therefore, may be seen that if the oil-water ratios do not increase, a fairly good recovery might be anticipated. However, should the water production increase, a very low recovery might result. The ultimate recoveries from this field will, primarily depend on the production characteristics.

Midale Field. The Midale pool is the largest known oil field in this area at the present time. This reservoir appears to be in a large Charles zone stratigraphic trap which is truncated at the northerly edge of the field. The reservoir rock is primarily composed of limestone with some anhydrite infilling. The porosity, which is generally of a fine intercrystalline type exhibiting low permeabilities, has an erratic development causing large variations in the effective void space throughout the field. There is no direct evidence of a water table even though the majority of the wells are producing water. A low gas-oil ratio of around 150 cubic feet per barrel is indicated. In view of the fact that the natural reservoir mechanism will no doubt be limited to a solution gas drive, a low primary recovery efficiency is, forecast.

An average pay zone thickness of approximately 40 feet is indicated. The effective porosity for this thickness is estimated to be around 10 percent. The connate water content appears to be very high and has been assumed to be 50 percent. Using these figures as a basis, the oil in place per average 80-acre well would be slightly in excess of 1,000,000 barrels. In view of the fact that the field may have an areal extent probably in excess of 30,000 acres, a large recoverable oil reserve is indicated, even though the primary recoveries may be low. The Midale crude is a medium gravity high sulfur type. As a result, considerable difficulty has been experienced in marketing this oil. Production from the field has been limited in the past.

Steelman Field. The Steelman field also appears to be the result of a large stratigraphic trap in the Charles zone. The productive horizon is thinner than that found in the Midale field but the average porosity development appears to be somewhat better. The erratic nature of this zone is again evident with large variations occurring in the effective void space development. Although several wells are of a marginal nature no dry holes have been reported in the field to date. In view of the fact that there have been no dry holes drilled between Steelman and the Kopp area to the west, the Lampman field to the north, and the Frobisher field to the east, a large productive area may be indicated. Very little factual data has been released on this field to date. It is believed that a good solution gas drive mechanism will exist and that the primary recovery efficiency should be around 20 percent. It is estimated that an average 80-acre well should have a primary recovery of around 125,000 barrels.



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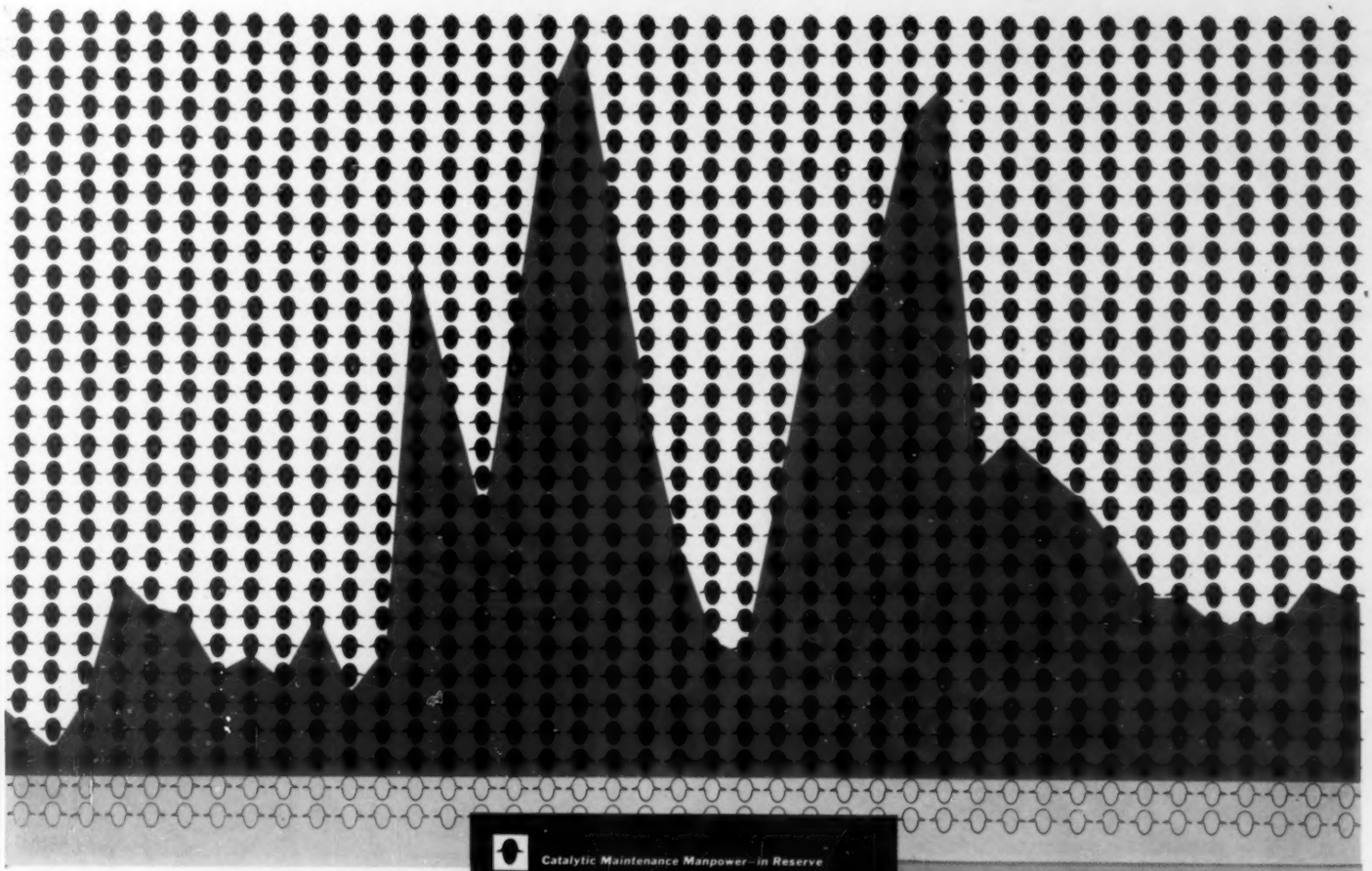

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TABLE 1

SOUTHEASTERN SASKATCHEWAN AREA
GENERAL FIELD DATA

Field	Weyburn (Ralph)	Midale	Steelman	Frobisher (Ch.)	Frobisher (M.C.)	Alida	Nottingham
Discovery Date:	December, 1954	May, 1953	January, 1955	June, 1954	March, 1954	November, 1954	February, 1955
Discovery Well:	Central Del Rio Ralph #14-6	Shell Midale A7-18	Imperial Steelman #1-8	Can. Gulf Moffat #11	Can. Gulf Quinn #19	Imperial Alida #4-35	Soc. W. S. Nott. #10-10
Discovery Well Location:	Lsd-14-6-7-13W2	Lsd-7-18-6-10W2	Lsd-1-8-4-5W2	Lsd-11-35-3-4W2	Lsd-9-34-3-4W2	Lsd-4-35-5-33W1	Lsd-10-10-5-32W1
Producing Horizon:	Charles	Charles	Charles	Charles	Mission Canyon	Mission Canyon	Mission Canyon
Average Depth—Ft.:	4,450	4,600	4,700	4,550	4,600	3,650	3,550
Oil Gravity—°A.P.I.:	30±	28	37±	37	40	40	37
Well Head Price—$/Bbl.	1.85	1.60	2.10	2.30	2.30	2.09	1.92
Present Spacing—Acres:	80	80	80	80	80	80	80
Present Number of Wells:	10	70	38	20	8	22	31

It is also possible that through secondary methods a large increase in these recoveries might be obtained. These recoveries combined with the areal possibilities could result in this field becoming of major size and importance.

It is interesting to note that, unlike Midale, a light gravity lower sulfur content crude is produced from this field. As a result, it is believed that the marketing of this oil will not be a problem. The allowable producing rates presently average around 50 barrels per well per day. Drilling is expected to proceed at a relatively rapid pace and, increases in the productive potential of this area are anticipated.

Frobisher Field. Production is obtained from both the Charles and Mission Canyon zones in the Frobisher field. The Mission Canyon reservoir is located in a nose type feature. This structure is reflected up into the Charles zone, however, the oil accumulation in that zone is believed to be more of a stratigraphic nature.

The Charles reservoir characteristics are quite similar to those of the Steelman field and, therefore, will not be discussed. The Mission Canyon reservoir is highly erratic having a thick oil-water transition zone. The relationship of porosity development to the structural position is important. This latter reservoir, although apparently small, is of a considerable significance in that it established commercial production in this zone. There have been a number of Mission Canyon shows between this field and the Midale area but the majority of them have been abandoned. Recently, however, several new discoveries immediately west of Frobisher have indicated commercial production possibilities. It is interesting to note that the gravity of these Mission Canyon crudes is around 40° A.P.I. and is, therefore, readily marketable.

Two rigs at work in the Royalite Oil Co. Ltd. Coleville, Saskatchewan, field. (Photo courtesy of Royalite Oil Co. Ltd.)

Alida Field. The discovery of light gravity crude in the Mission Canyon zone of the Alida field during November 1955 gave exploration in this overall area a terrific boost. A thick highly porous oil pay zone was encountered. The shallow depth, some 3,600 feet, meant inexpensive development and indicated the possibility of high returns.

The geology of this field is characterized by a sharp erosional type feature nosing in a southwesterly direction. An excellent degree of porosity and permeability development has been noted throughout the producing zone in this field. A gas cap is apparent in the central and northern portions of the reservoir. The oil zone is underlain by a thick water bearing section. The gas-oil contact has been fairly well established, however, it appears that a sloping water table exists. This latter condition is further complicated by the fact that an oil-water transition zone is also apparent. An average effective oil zone thickness of around 35 feet is indicated. This thickness might be increased substantially by addition of part, or all of, the transition zone. The porosity is estimated to average around 14.0 percent. A water drive will probably exist and, therefore, an efficient recovery mechanism is indicated. It is believed that an average 80-acre well in this area will probably recover in excess of 500,000 barrels.

Although this field indicated the prolific nature of this area, it is demonstrated some of the hazards. The tilted water table, for example, can render structurally high locations barren. The sharpness of the structure places step-out drilling almost on a wildcat basis. It is an area where good structural and reservoir control will be of necessity.

Nottingham Field. The Nottingham field is situated approximately six miles southeast of the Alida field and in many ways is similar to that reservoir. The gravity of the crude is somewhat less, being around 37° A.P.I., and there is only a very small gas cap. A thick oil zone is again evident, being close to 100 feet thick in some wells. The Nottingham field, which is somewhat larger than Alida, appears to be even more prolific.

Since this field was found there has been a phenomenal discovery rate in this particular area. New fields of a similar prolific nature, have been found at Ingoldsby, North Hastings, South Hastings, Lemieux, Cantal, etc. There has also been an indicated Charles zone discovery immediately to the south in the general Carnduff area. The rate of these discoveries is certainly of noteable importance to the oil industry in Saskatchewan.

There have been a number of recent discoveries in the general Steelman area. The area between the Steelman and Alida sectors may also reveal large potentialities. Very little testing has been carried out in the lower formations, particularly the Devonian horizons. This possibility could certainly add optimism to the entire area. It is, therefore, believed that this general region of Saskatchewan will no doubt become a major producing area.

The Southwestern portion of Saskatchewan was very active during 1955 from a development standpoint. The completion of the South Saskatchewan Pipe Line Company Ltd. system in the fall of 1954 provided a connection from the general Cantuar-Fosterton area to the Interprovincial line at Regina. This system now provides an economic outlet for the medium gravity crudes produced in this area. It is reported that pipeline runs are at approximately 15,000 barrels per day. This oil is shipped to a refinery market in the Minneapolis-St. Paul area. The creation of this market has hastened the delayed development of these fields. An increase in exploration activity in this area may now be anticipated.

The general Coleville-Lloydminster area has also experienced another busy year. Active development of the Coleville heavy crude field has continued. Production has risen to over 6,000 barrels per day in this field. The Lloydminster area production has been maintained at close to 5,000 barrels per day. The Smiley-Coleville gas field was unitized and officially placed on production. This gas reserve will be used to supply the general Saskatoon area. The latest statistics indicate that over 20,000 mcf. per day are being produced.

The Southeastern portion of the province presently holds the spotlight, however, new areas such as the more northerly regions which are now being investigated might be next. In any event the oil industry in Saskatchewan had a big year in 1955 and the possibilities for 1956 look brighter.

MANITOBA

By Leslie Orr Rowland[1]

Production in Manitoba increased 93 percent in 1955 as development drilling brought 305 completions. Less active wildcatting brought in ten discoveries.

FINDING oil in Manitoba in 1955 proved to be a much easier task than it had been in any previous year, as the number of discoveries set a new all-time success ratio. Ten pool or field discoveries were recorded out of 54 wildcats which finished drilling in the calendar year, to yield a discovery of ratio of better than one in six. In 1954 it had taken 83 wildcats to attain nine discoveries, for a ratio of not quite one in nine.

Wildcatting dropped nearly 40% but total completions soared to a record of 359. Development wells numbered 305 against the 1954 total of 224. Development oil well completions totaled 271 against 202 the previous year, while 24 dry holes compared with 17 in 1954 and 10 service wells were drilled, double the 1954 record.

The decline in wildcat drilling was apparently due in large part to the completion of several extensive wildcat programs by companies which were active throughout the Mississippian area of the province in 1954. Some of these programs were entirely negative, with no commercial shows in a dozen wildcats, and the operators withdrew to greener pastures for their 1955 exploration. A pause for evaluation before setting up any more budgets for Manitoba was the common decision at the 1954 year-end.

One of the features of 1955 wildcatting was the concentration on the area underlain by Mississippian sediments. Last year only six wildcats were drilled beyond the Mississippian truncation line which was fairly closely established in 1954.

The results of drilling in these regions apparently were not entirely negative, however, because early in 1956 three companies bought large exploration permits and leases in portions of Manitoba east and north of the indicated limits of Mississippian formation. As these parcels all carry work commitments, it appears likely that this year will see some increased activity in search of other than Mississippian objectives.

Drilling contractors had a busier year in 1955 than in 1954, but the shallower average depth of wells with the swing to development drilling resulted in a more modest increase in footage drilled than in wells which finished drilling. Manitoba's 847,546 feet of hole was an increase of 9% over the 772,703 feet sunk in 1954, while the total number of wells increased by more than 16%.

Increasing knowledge about Manitoba limestone reservoirs, and the proof by production history that in several cases the fields have become marginal producers because of sharp decline curves and water production problems, led several operators to resort to economy measures in drilling and completion practice. The use of 4½-inch production casing in place of the traditional 5½-inch or 7-inch casing, involving a considerable saving in steel tonnage, was adopted exclusively by at least one operator and appears to be a growing trend. This permits the drilling of wells with 6⅛-inch bits instead of 8¾-inch or 9-inch, saving cost and rig time. Another innovation introduced in 1955 was the use of 12¼-inch bits for drilling surface hole, which in turn permitted the use of 8⅝-inch surface casing instead of 10¾-inch casing in a hole drilled with 13¾-inch bits. One operator experimented with 9-inch surface hole for 7-inch casing, with satisfactory results.

Operators report no difficulty in running tubing and getting workover or servicing tools into the hole through the narrow casing. In fact almost universal completion practice is to release the rig as soon as casing has been set and complete with a service rig, of which several are available in the Virden area where most activity was centered in 1955.

Most development completions in 1955 were in the three major fields in the Virden region. The rapidly developing North Virden field took top place with 96 new oil wells and only two dry holes. Virden-Roselea, the closely related field to the south, was second with 88 oil wells, three salt water disposal wells and four dry holes. The Daly field, original Manitoba discovery, had 39 oil well completions, three dry holes, and six water injection wells. Thus the 223 new oil wells which finished drilling in these three fields accounted for 80% of the entire oil well completion total last year.

The experience gained in more than a year of experimenting with different fracturing and acidizing techniques was applied in 1955 to standardizing completion practices in most of the fields.

Brewster N4 rig commonly used in Manitoba operations. Excess depth rating (4,000 feet) compensated by greater speed of drilling 2,000-foot wells.

In the Daly field two alternate methods were used. Some wells were completed with casing set to the top of the pay zone and acidized with 250 gallons of XFMW acid or 15% HCl. Those which were cased through were perforated with four to eight shots per foot through the casing, then acidized with 250 gallons of 15% HC1. In both cases Sandfrac treatment followed before placing the well on pump.

The typical Sandfrac job was 1,000 to 2,000 gallons of gel carrying 5,000 to 10,000 pounds of sand, or 72 to 192 barrels of crude carrying similar amounts of sand. The commonest application was through open end casing with oil added at the rate of 2 lb/gal at pumping rates of 6 bbl/min.

In the North Virden and Virden-Roselea fields both completion methods were used. Wells which set casing at the top of the pay zone were acidized. North Virden acidizing treatment was normally 500 gallons of mud acid and a squeeze with 500 gallons of XFMW. In the Virden-Roselea field the common treatment was four barrels of MCA and four barrels of XFMW, or an acid-frac with 1,000 gallons of gel carrying 2,500 to 3,600 pounds of sand.

[1] Editor, *Oil in Canada*

Exploration and Development

Wells cased through the pay zone were perforated in a small interval of five to ten feet at the bottom of the zone with four to eight shots per foot and acidized with two barrels of MCA and four to ten barrels of XFMW through the perforations. Sandfrac was used occasionally in the North Virden field, with a maximum of 7,500 pounds of sand carried in 128 barrels of oil.

Wells in the recently discovered Routledge field have mostly been washed with 200 gallons of mud acid, followed by a squeeze of 250 gallons of 15% HCl.

The other minor fields were drilled out to practically full development in 1955, including those which were 1955 discoveries, with the single exception of the South Regent field. Development oil wells drilled in the Maples field numbered 12, while eight each were drilled in the Ebor and Routledge fields, seven at Woodnorth, three at South Regent, two at Tilston, and one each at Coulter, Kirkella, Lulu Lake, Pierson, Regent, Waskada, West Ebor and Whitewater.

A great deal of reservoir information was put on the public record at two provincial government hearings on maximum permissive rates of production. The Daly field was described as a marginal operation. Development at the end of 1955 was almost complete, except for possible north extensions. There were 175 wells capable of producing the field at the end of the year. The water flood project, started in 1954 and enlarged in 1955, showed some beneficial effects on recovery.

The North Virden field, with its average effective pay thickness of 42.4 feet and porosity of 11.99%, is now believed to have a solution gas drive as its dominant recovery mechanism. The ultimate development, estimated at 126 wells in the November MPR hearing, appears likely to go considerably beyond this figure. By the end of the year there were 131 wells capable of producing and the limits at the north had not been indicated. A revised estimate in the light of early 1956 completions would indicate at least 200 wells as ultimate.

The Virden-Roselea field, with its north, west and south limits more nearly defined, is still open in the east. At the end of 1955 it contained 159 wells capable of producing. Solution gas drive is dominant, although a bottom hole pressure survey last summer indicated a fairly active water drive in the central and northwest portions.

Both Whitewater and Ebor fields are now stripper operations, while the small Tilston, Pierson and Lulu Lake fields are fairly closely delimited for economic drilling and considered marginal. Most wells in these minor fields are unable to make the allowable and some have substantial water cuts.

The Maples field, discovered in 1955, is smaller than was hoped, with ultimate development calculated as 20 wells, of which 13 were producing at the end of the year. Connate water at 45% average is unusually high, and this has prompted completion of the majority of wells in the zone above the Crinoidal.

The Woodnorth field, now just about fully developed, is the most promising of the minor fields, with 16 wells capable of producing at the year-end. The reservoir behavior has been excellent. Calculations of bottom hole pressure decline indicate an extraordinarily active water drive which has been effective since the end of 1954 and is now yielding oil withdrawal per pound drop in reservoir pressure which is 14 times greater than was realized prior to that time. The average net pay zone thickness is 13 feet.

Salt water disposal facilities were increased in all fields during 1955. Both the Cooking Lake member of the Devonian, below the producing formations, and the Viking sand above the Mississippian producing members, are being used for disposal, with satisfactory input rates.

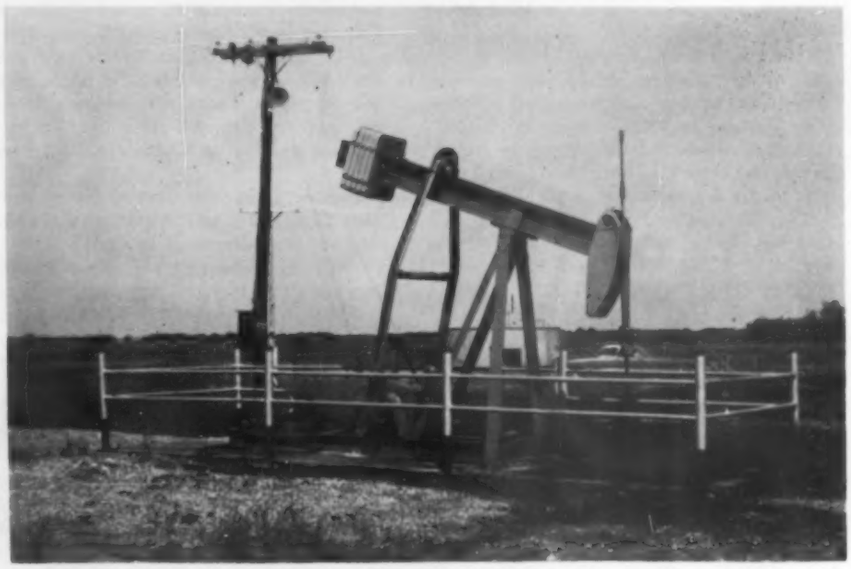
By the end of the year it was apparent that none of the 10 oil discoveries was going to result in a substantial oil field, but the discoveries contributed information indicating a distinct trend of oil pools running southeast from the general Virden area towards the Whitewater field. All 1955 discoveries were made in the Lodgepole member of Mississippian limestone, the oldest portion of the Mississippian to be found in the province. The Lodgepole is the last member to be truncated in the progressive pattern of erosion which has caused successively younger beds to be truncated to the west and south of the now clearly indicated line of the easterly limit of Mississippian Limestone. Both the Tilston and Pierson fields, near the western boundary of the province, produce from the Mission Canyon member, next above the Lodgepole and the prolific oilbearing formation in southeastern Saskatchewan fields a short distance west.

Wildcats drilled in 1955 made very little contribution to structural or stratigraphic knowledge below the Mississippian, as the number of basement tests was negligible and few wells penetrated beyond the Devonian top, leaving most of the Devonian and all the Silurian and Ordovician practically untouched.

Wildcat drilling was dominated by Souris Valley Oil Co., Ltd. which farmed out a large part of its checkerboarded acreage in the southwestern sector of Manitoba in several blocks on which commitment wells were drilled in 1955. Twelve dry wildcats were drilled on Souris Valley farmout acreage, nearly one quarter of the total completions. Drilling on these farmouts would have been even larger but for an unusually early and severe winter which handicapped rig movement after October.

Although so little drilling was done outside the Mississippian area in 1955, results of stratigraphic analysis on some wells indicated enough prospects in the Jurassic formation to encourage the acquisition of two large exploration permits by two major

Virden-Roselea pump with electric power-battery in background.



oil companies, early in 1956, covering Crown rights outside the Mississippian truncation line. Shell Oil Company bought for cash bonus of $52.005 the exploration rights on two large blocks comprising more than 340,000 acres, on which work commitments to the value of at least $100,000 must be done before Jan. 26, 1957. California Standard Company paid $1,913 for a reservation of over 190,000 acres with work commitments of $20,000. The Shell holding runs north and west from the Spruce Woods Forest Reserve to Riding Mountain National Park. The Cal-Standard block is located west of the park. Practically no drilling has been done in these regions, and a discovery would generate tremendous interest since the Mississippian is still the only source of Manitoba oil production.

Five Crown reserve lease sales in 1955 will lead to a greatly increased amount of wildcat drilling this year. They brought into the province several major companies which had not been represented before and resulted in increased holdings by companies already operating in Manitoba.

One of the outstanding entries of the year was the arrival of Amerada Petroleum Corporation, by the Crown reserve route, with the bulk purchase of the entire lease rights offered at a sale on March 8 for cash bonus of $152,844. For this price Amerada got 16,571 acres of wildcat rights. Amerada extended its holdings at two subsequent sales in August and November.

Canada Cities Service Petroleum Corporation entered Manitoba in August and Canadian Gulf Oil Company was another new entrant at the November sale.

The largest sale of the year, held on November 10, attracted bids from an impressive number of major and independent companies on a total of 69 parcels and brought a total of $241,562 in cash bonus bids by the winning bidders for more than 31,000 acres. Amerada again was the largest bidder with $76,783 for several straight leases and a drilling reservation. Canadian Gulf bids totaled $64,963. Imperial Oil Limited, the other major buyer, paid $55,-144.

Analysis of the discoveries of 1955 shows that little in the way of new reserves was added but the area of concentrated success was widened and the impression created that another substantial field may be found in this area which, as mentioned, runs from Virden-Roselea southeast to Whitewater.

The Maples field was discovered by Imperial Virden 5-9, lsd 5-9-10-26WPM, drilled by Imperial Oil Limited. This well finished drilling on Feb. 16, 1955, at total depth 2,240 ft. (782 ft. subsea), set production casing at the same depth and was placed on pump on February 25 after establishing open flow initial potential of 600 b/d. There were 13 wells capable of producing at the end of 1955. The field was three miles southwest of the Virden-Roselea field when discovered, but extension of the latter has since made their official boundaries contiguous, although they are clearly on separate structures.

The Routledge field, three miles southeast of the Virden-Roselea field, was discovered by McCarty & Coleman Routledge 3-33, 1sd 3-33-9-25WPM, which was drilled by McCarty & Coleman, a partnership from Great Falls, Montana which had been active in Manitoba wildcatting without much success all through 1954 and 1955. The well finished drilling on May 25, 1955, at total depth 2,080 feet (644 feet subsea), set production casing at the bottom of the pay zone, at 2,052 feet, perforated the interval 1,996—2,000 feet and placed on pump production on June 7. Thickness of pay zone in this field averages 20 feet, compared to 10 feet in the Maples field, but otherwise producing characteristics are similar and both fields are vulnerable to water instrusion with the oil production. At the end of the year there were nine wells capable of producing.

The most encouraging of the other discoveries was a wildcat in the Regent area, which recently has shown promise of being linked with the South Regent pool discovered late in 1954 by The California Standard Company 4½ miles to the southeast. The 1955 discovery well is Dome Naco South Regent 1-34, 1sd 1-34-4-22WPM, drilled by Dome Exploration (Western) Limited and Naco Ltd. It finished drilling on July 21, 1955, at total depth 2,513 feet (859 feet subsea), set production casing at 2,497 feet and went on pump on September 3. Indicated thickness of pay zone was 28 feet, a little more than half the average of 50 feet in the South Regent pool.

The significance of this well lines in the results of two wells drilled subsequently. An Imperial development well 1½ miles southwest was completed recently as an assured producer, and an Imperial wildcat three miles southeast of the latter well and three miles west of the South Regent pool was completed near the end of February 1956, as an indicated commercial discovery.

The implication of these operations is that the four points of oil success enclose a pool whose dimensions are at least four by 2½ miles with a total of 80 or more potential well sites on the conventional 40-acre spacing. If this turns out to be the case, the Regent area may provide the substantial field for which the industry has been looking without success since the Virden-Roselea and North Virden discoveries of 1953.

Another interesting discovery area is at West Butler, 3½ miles west of the Ebor field and six miles west of the Daly field. This rapidly developing pool, discovered by California Standard in November, may have picked up a trend west from Daly, as there is wide-open territory for another ten miles across the border into Saskatchewan. There is a distinct probability that the West Butler pool will cross the provincial border when it is fully developed. The discovery well was California Standard West Butler 1-31, lsd 1-31-9-29WPM, which finished drilling on November 3, 1955, at total depth 3,031 feet (1,247 feet subsea), set production casing at 2,857 feet and went on pump production on November 18. Three development wells had been completed successfully up to the end of February, indicating the possibility of another substantial oil accumulation. Thickness of pay zone, reported unofficially as 100 feet, compares very favorably with the average thickness of pay in the major Manitoba fields.

The other discoveries of 1955 remained as single oil wells at the end of the year and in three cases were suspended for evaluation of production methods and analysis of their future economic potential.

Crude oil production soared with the rapid increase in development drilling. In 1955 the average production rate rose from 8,800 b/d in January to 14,262 b/d in October. The unusually early and severe winter reduced production for the final two months, as roads drifted in with snow and batteries not already connected to pipe line transportation could not be reached by tank trucks. Through January and February there were about 80 wells shut in for lack of transportation, so that actual producibility at the end of the year was at least 17,000 b/d.

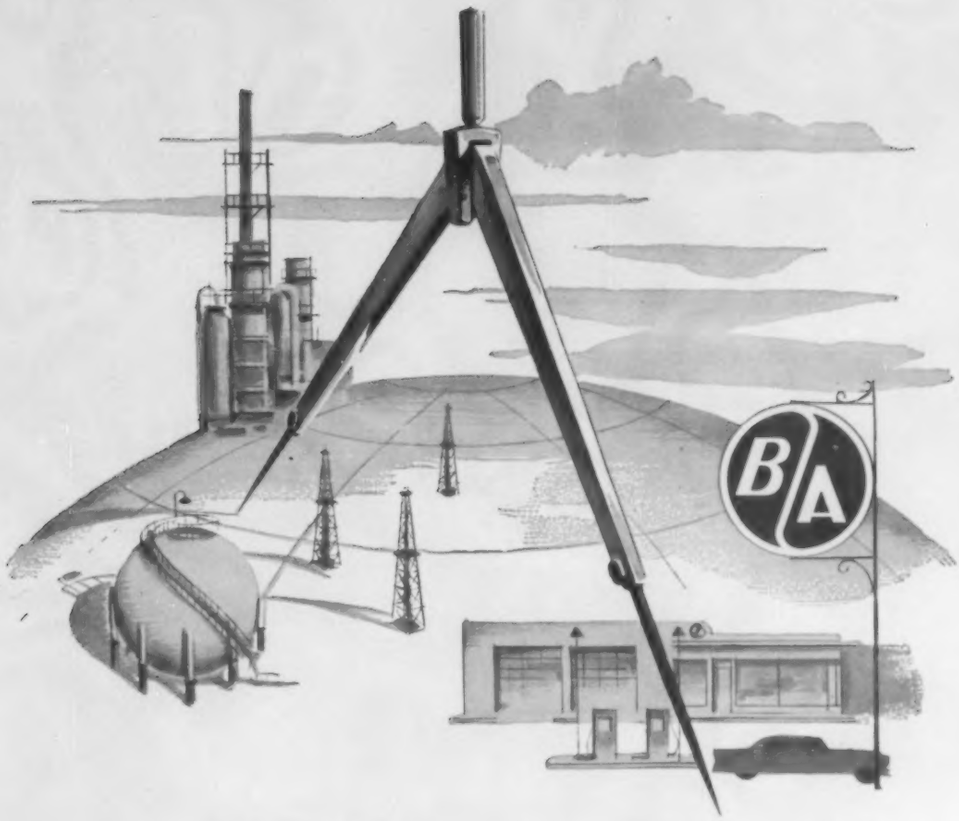
Total oil production set a new high mark of 4,145,756 barrels, almost double the 1954 production total of 2,148,184 barrels. Forecast 1956 production, assuming only the increase which will accrue from further development of existing fields and ignoring any increment from new discoveries, is 7,300,000 barrels or an average of 20,000 b/d, with a year-end rate approaching 25,-000 b/d. Marketing conditions for Manitoba crude continued favorable in 1955, with no pro-rationing of production required, and this trend is expected to continue in 1956.

It is significant that the increase in average daily production at the end of the year was sustained in spite of a general reduction of MPR rates during 1955. The allowables in general are above the capacity of the majority of wells in the major fields, and thus the above-average wells are permitted a production rate more in accordance with their relative performance than is the case in Alberta. The latest schedule of field allowables for individual wells, set after the November MPR hearing is as follows:

Field	*B/D*	*Field*	*B/D*
Daly	75	Whitewater	45
Virden Roselea	60	Pierson	45
N. Virden	70	Tilston	35
Woodnorth	45	Lulu Lake	40
Routledge	50	South Regent	50
Ebor	35	Maples	45

Manitoba well completions 1947 to 1955 inclusive;

Year	*Wildcat*	*Devel.*	*Total*	*Cumul.*
1947	1	0	1	1
1948	0	0	0	1
1949	4	0	4	5
1950	6	0	6	11
1951	13	4	17	28
1952	40	31	71	99
1953	28	67	95	194
1954	83	224	307	501
1955	54	305	359	860
Cumul.	229	631	860	860



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50TH YEAR

Bulldozer clearing a seismic line in western Alberta, Canada. (All photos used in this article, except for those specified, are Shell Oil Co. photos.)

WESTERN CANADA exploratory drilling operations in 1955

By Floyd K. Beach

Exploratory drilling declined in 1955, but development drilling was up strongly, to make the total of wells drilled higher than the previous year. Of the 246 successful exploratory wells, 152 were classified newfield wildcats, indicating a new field or a very long extension.

THE total of wells drilled in western Canada during 1955 was up sharply compared with 1954. 2,935 wells were drilled, compared with 2,293 in 1954. The average depth in 1955 was 4,350 feet, compared with 4,000 in 1954.

The above figures include in both years wells drilled for salt water disposal, which in 1955 numbered 24, as against three in 1954. During 1955 some 15 wells drilled for potash exploration were included, since they penetrated most horizons from which oil and gas are obtained elsewhere.

Development drilling showed the greatest increase and exploratory drilling was slightly less than in 1954. Of 1,199 development wells in Alberta, 626 were drilled in the Pembina field where average depth is about 5,250 feet. Both Saskatchewan and Manitoba had relatively large increases in development drilling.

Of the exploratory wells drilled, 718 were rated as New-Field Wildcats according to the rules of A.A.P.G. Committee on Statistics of Exploratory Drilling, headed by Dr. F. H. Lahee. A questionnaire circulated by the Canadian Petroleum Association indicates that 650 of these wells were located on technical bases, with 149 of them finding oil or gas for a 23% success. Non-technical and unknown location basis amounted to 68 wells of which three found oil or gas for a success ratio of 4.4%. The 68 non-technical or unknown location basis included 15 wells drilled for potash exploration and if we eliminate them, the 53 remaining wells succeeded in 5.7% of the holes, but still show a sharp drop from those located on a technical basis.

Of the 246 successful exploratory wells completed during the year, 152 were in the category "New-Field Wildcats" and their completion technically calls for a named "new field" or a very long extension

To select really important discoveries from such a long list might lead to invidious comparisons and a feeling among some operators that we have lightly brushed off their discoveries. However, we have in the discussion that follows aimed to touch mostly on new pay horizons and discoveries that are a long distance from known fields, together with discoveries that occurred early enough in the year to permit of evaluation by extension drilling. Gas discoveries have been lightly treated generally because of the problem of utilization.

Alberta. Mobil Oil Wilson, about six miles southeast of Lethbridge city limits, found oil in the Madison lime with initial production of 148 barrels per day in October. An earlier failure about 1¼ miles west northwest and some doubt as to the success of a follow-up to the discovery lead to doubt as to the extent of the field.

Mobil Oil found high sulfur gas in a well on the outskirts of Calgary, raising hopes that the Okotoks field, some 25 miles to the south, may extend right through. Both occurrences are in the uppermost Devonian. An intervening failure does not necessarily show that the occurrences are discontinuous but the carbonate rocks are low in

Century Geophysical Corps. seismic crew operating with tracked equipment in the Sturgeon Lake area of Alberta.

An old well now on pump in the once rich Turner Valley oilfield near Calgary.

Swivel frame pickup truck acquired by Shell Oil Co. for use in rugged country. Truck frame is cut directly behind the cab. Forward and rear sections are connected by a sleeve-fitting swivel. The design allows the driving power to remain in contact with the ground at all times. The swivel also prevents twisted frames.

Stanolind Oil and Gas Co. wildcat well, Pembina area, Canada. (Photo courtesy of Stanolind Oil & Gas Co.)

TABLE I. COMPARISON OF EXPLORATORY RESULTS—1955

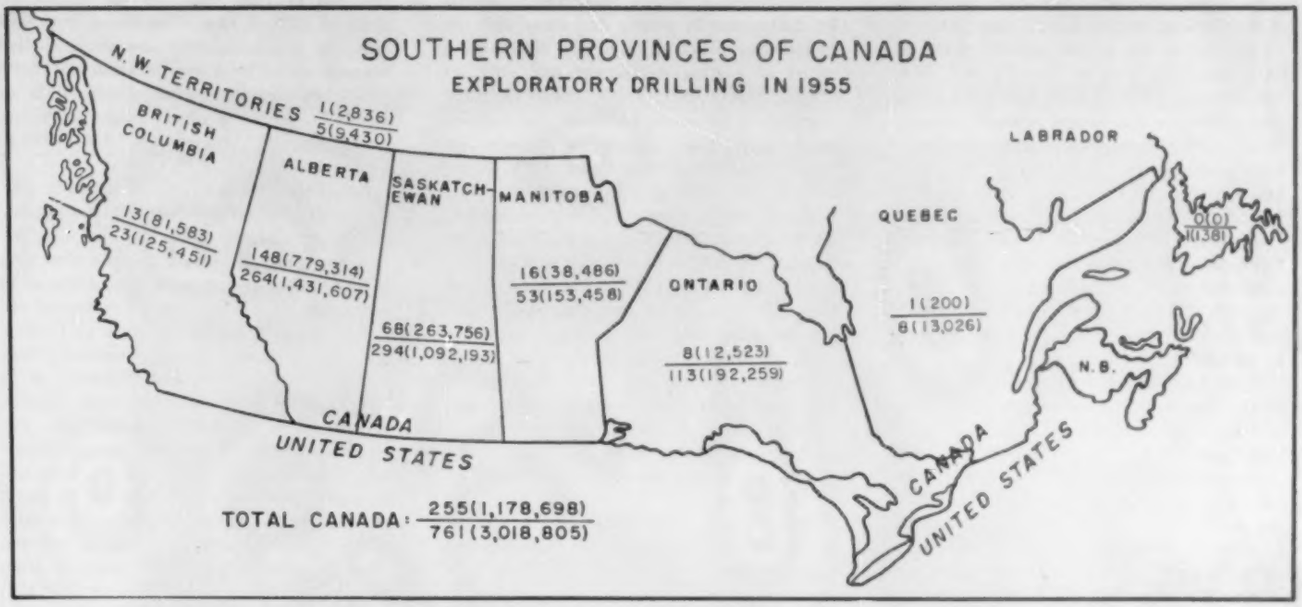
	Completed Discoveries & Extensions					Completed Exploratory			
1955	Total	Gas	Oil	Rate Gas	Rate Oil	Total	Rate Gas	Rate Oil	% Total
Alta.	148	70	78	47%	53%	412	17.0%	19.9%	36.0%
Sask.	68	15	53	22%	78%	362	14.3%	15.0%	19.3%
B. C.	13	12	1	92%	8%	36	33.3%	2.8%	36.1%
Man.	16	0	16	0	100%	69	0	23.2%	23.2%
N. W. T.	1	1	0	100%	0	6	16.7%	0	16.7%
W. Canada	246	98	148	40%	60%	885	11.1%	16.7%	27.8%
E. Canada	10	7	3	70%	30%	132	5.3%	2.3%	7.6%
Total Canada	256	105	151	41%	59%	1,017	10.3%	14.8%	25.2%
1954									
Alta.	152	66	86	44%	56%	363	14.3%	18.2%	32.5%
Sask.	65	19	46	29%	71%	342	4.4%	8.2%	12.6%
B. C.	14	14	0	100%	0	14	28.6%	0	28.6%
Man.	20	0	20	0	100%	87	0	23.0%	23.0%
N. W. T.	0	0	0	0	0	6	0	0	0
W. Canada	251	99	152	39%	61%	812	8.8%	14.0%	22.8%
E. Canada	10	10	0	100%	0	112	8.9%	0	8.9%
Total Canada	261	109	152	42%	58%	924	8.8%	12.3%	21.1%
1953									
Alta.	61	40	21	66%	34%	292	13.7%	7.1%	20.8%
Sask.	26	4	22	15%	85%	273	1.5%	8.0%	9.5%
B. C.	7	7	0	100%	0	23	30.0%	0	30.0%
Man.	2	0	2	0	100%	21	0	9.5%	9.5%
N. W. T.	0	0	0	0	0	6	0	0	0
W. Canada	96	51	45	53%	47%	615	8.3%	7.3%	15.6%
E. Canada	2	1	1	50%	50%	59	1.7%	1.7%	3.4%
Total Canada	98	52	46	53%	47%	674	7.7%	6.8%	14.5%

TABLE III. EXPLORATORY DRILLING IN CANADA IN 1955

		Oil		Gas		Total Producers		Dry Holes		Grand Total	
Province	Well Classification	Number	Footage	Number	Footage	Number	Footage	Number	Footage	Number	Footage
Alberta	Outposts	33	182,512	8	22,156	41	204,668	20	85,894	61	290,562
	New-Pool Wildcats	7	43,585	3	9,760	10	53,345	9	50,738	19	104,083
	Deeper-Pool Tests	3	3,294	1	530	4	3,824	16	19,276	20	23,100
	Shallower-Pool Tests	4	15,736	1	3,460	5	19,196	0	0	5	19,196
	New-Field Wildcats	31	200,407	57	297,874	88	498,281	219	1,275,699	307	1,773,980
	Total	78	445,534	70	333,780	148	779,314	264	1,431,607	412	2,210,921
British Columbia	Outposts	0	0	0	0	0	0	1	6,440	1	6,440
	New-Pool Wildcats	0	0	1	6,580	1	6,580	0	0	1	6,580
	New-Field Wildcats	1	8,060	11	66,943	12	75,003	22	119,011	34	194,014
	Total	1	8,060	12	73,523	13	81,583	23	125,451	36	207,034
Manitoba	Outposts	1	2,104	0	0	1	2,104	0	0	1	2,104
	New-Pool Wildcats	4	8,732	0	0	4	8,732	2	5,309	6	14,041
	Deeper-Pool Tests	0	0	0	0	0	0	3	1,486	3	1,486
	New-Field Wildcats	11	27,650	0	0	11	27,650	48	146,663	59	174,313
	Total	16	38,486	0	0	16	38,486	53	153,458	69	191,944
Northwest Territories	New-Field Wildcats	0	0	1	2,836	1	2,836	5	9,430	6	12,266
	Total	0	0	1	2,836	1	2,836	5	9,430	6	12,266
Saskatchewan	Outposts	15	60,750	0	0	15	60,750	11	35,203	26	95,953
	New-Pool Wildcats	10	41,851	3	4,929	13	46,780	9	29,114	22	75,894
	Deeper-Pool Tests	0	0	0	0	0	0	2	1,375	2	1,375
	New-Field Wildcats	28	119,367	12	36,859	40	156,226	272	1,026,501	312	1,182,727
	Total	53	221,968	15	41,788	68	263,756	294	1,092,193	362	1,355,949
Total Western Canada	Outposts	49	245,366	8	22,156	57	267,522	32	127,537	89	395,059
	New-Pool Wildcats	21	94,168	7	21,269	28	115,437	20	85,161	48	200,598
	Deeper-Pool Tests	3	3,294	1	530	4	3,824	21	22,137	25	25,961
	Shallower-Pool Tests	4	15,736	1	3,460	5	19,196	0	0	5	19,196
	New-Field Wildcats	71	355,484	81	404,512	152	759,996	566	2,577,304	718	3,337,300
	Total	148	714,048	98	451,927	246	1,165,975	639	2,812,139	885	3,978,114
Newfoundland	New-Field Wildcats	0	0	0	0	0	0	1	1,381	1	1,381
	Total	0	0	0	0	0	0	1	1,381	1	1,381
Ontario	Outposts	0	0	3	3,946	3	3,946	3	2,118	6	6,064
	New-Pool Wildcats	1	1,498	1	1,215	2	2,713	46	77,054	48	79,767
	Deeper-Pool Tests	0	0	0	0	0	0	3	6,705	3	6,705
	New-Field Wildcats	1	1,989	2	3,875	3	5,864	61	106,382	64	112,246
	Total	2	3,487	6	9,036	8	12,523	113	192,259	121	204,782
Quebec	New-Field Wildcats	0	0	1	200	1	200	8	13,026	9	13,226
	Total	0	0	1	200	1	200	8	13,026	9	13,226
Total Eastern Canada	Outposts	0	0	3	3,946	3	3,946	3	2,118	6	6,064
	New-Pool Wildcats	1	1,498	1	1,215	2	2,713	46	77,054	48	79,767
	Deeper-Pool Tests	0	0	0	0	0	0	3	6,705	3	6,705
	New-Field Wildcats	1	1,989	3	4,075	4	6,064	70	120,789	74	126,853
	Total	2	3,487	7	9,236	9	12,723	122	206,666	131	219,389
Total Canada, all classes		150	717,535	105	461,163	255	1,178,698	761	3,018,805	1,016	4,197,503

SOURCE

Exploratory Drilling in 1955. Dr. Frederic H. Lahee, Chairman, AAPG Committee on Statistics of Exploratory Drilling; formerly Geological and Research Counselor, Sun Oil Co.; retired, Sept. 1, 1955; now a consulting geologist at Dallas. Dr. Lahee's complete article will appear in the June 1956 issue of the *Bulletin of the American Association of Petroleum Geologists*.



Legend: Number of producers above line, left; total producer footage drilled, above line in parentheses; number of dry holes below line, left; total dry hole footage drilled, below line in parentheses. (From the report of the Statistical Committee of the American Association of Petroleum Geologists)

porosity and permeability and it is likely that there is marked lack of continuity of the reservoir.

Husky-Northern-Target made a significant discovery, with a large flow of gas in the front range of the Rocky Mountains, and from this standpoint the well opens a new province for gas. Gas was actually discovered in 1954 but completion of testing ran on into 1955.

Shell extended the Olds gas field for several miles by a well rated as a wildcat. Its gas production is also high in sulfur and is in the uppermost Devonian, again suggesting some continuity of sulfur gas with the Okotoks field.

H. B. Sundre 1, in 1 of 4, 34-5 W.5, found oil in the Mississippian Elkton member in January and the field has developed nicely during the year.

H. B. Oilwell Operators Westward Ho 1, in 7 of 8, 33-4 W.5, considered an outpost from the Olds gas field, found oil, also in the Elkton member of the Mississippian in February and a nice field has been developed during the year with expansion continuing.

Oilwell Operators C. & E. Harmattan 9-5 in 9 of 5, 32-4 W.5, found gas in the Elkton in September and a follow-up in 1 of 7, 32-4 W.5 found oil in the same horizon and gives promise of a third field in the general area with perhaps eventual connection of the three. All of them are reasonably close to Calgary, coming within about 50 miles of the city. Calgary refineries have been dependent on the declining Turner Valley field which has pipeline connections, plus rail deliveries from other fields. Decision has been reached to build a pipe line outlet from Sundre, Westward Ho and Harmattan to Calgary.

Cardium oil discoveries at two rather widely spaced wells drilled by Texaco suggest quite a good sized field should they join up. Locations are in 10 of 20, 41-6 W.5 and 8 of 18, 42-6 W.5.

Imperial found a long extension to the Joffre field in Burbank, 13 of 15, 39-27 W.4.

A new pay was found in the Pembina field in Imperial Canadian Superior Buck Creek 16 of 30, 48-6 W.5, when oil was found in basal Belly River sand and several development wells have followed. California Standard found gas in the same sand at Ferrybank, 2 of 8, 44-27 W.4. The Ferrybank well also had good oil showings in Ireton shale—apparently from fractures.

Several long extensions to Pembina field have enlarged this most active field and within the general outlines of Cardium production we have considered as development even long step-out locations.

TABLE II. TOTAL WELLS DRILLED—WESTERN CANADA, 1955 & 1954

	N.W.T.			B. C.			Alta.			Sask.			Man.			Total		
	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total	Dev.	Expl.	Total
1955																		
Oil	0	0	0	0	1	1	1059	78	1137	496	53	549	254	16	270	1809	148	1937
Gas	0	1	1	0	12	12	65	70	135	5	15	20	0	0	0	70	98	168
Dry	0	5	5	0	23	23	75	264	339	45	294	339	27	53	80	147	639	786
Total:	0	6	6	0	36	36	1199	412	1611	546	362	908	281	69	350	2026	885	2911
1954																		
Oil	0	0	0	0	0	0	597	86	683	345	46	391	186	20	206	1128	152	1280
Gas	0	0	0	0	14	14	68	66	134	5	19	24	0	0	0	74	99	173
Dry	0	6	6	0	12	12	100	276	376	39	305	344	21	79	100	160	677	837
Total:	0	6	6	0	26	26	765	428	1193	389	370	759	207	99	306	1362	928	2290

At South Sturgeon Lake, Shell found oil in the Triassic, establishing a new pay.

Gulf found oil in the granite wash at its Clear Hills well in 4 of 15, 88-2 W.6, establishing a new pay, while Union Evans and Hudson's Bay found a small oil producer in the Springburn, lowermost Devonian present there and only a short distance above the basement; location 15 of 15, 80-16 W.5. Stanolind found oil in the "Gillwood sand," believed to be of Cambro-Ordovician age, and also just above the basement rocks. Its location is 6 of 20, 65-20 W.5. The three discoveries together point to the possibilities of the beds almost at basement.

Aside from the discoveries above recited there have been numerous gas discoveries and some oil discoveries that seem to mark small pools.

Saskatchewan. Numerous discoveries of oil are grouped in the southeastern part of the province. It is possible that Kingsford, Lampman, Steelman and Frobisher may join or nearly so. A little farther west and north, Webburn field is reaching toward Midale. All these are in Mississippian. Two wells between these fields, rather widely spaced, found oil.

To the west, Bone Creek field was discovered by a group—Delhi, Husky, Phillips and Richfield in 11 of 19, 11-21 W.3, getting oil in Upper Shaunavon (Jurassic) equivalent of Rierdon or Stockade Beaver. Several follow-up wells have been successful.

Mobil Oil found oil in the Roseray sand (Jurassic) at Battrum, 6 of 28, 18-17 W.3 in February and has developed a field of 23 oil producers, many on 80-acre spacing.

Several discoveries fairly late in the year have not yet been evaluated. Long extensions of the Hatton gas field (an eastward extension of Alberta's Medicine Hat field) have thin sand but appear to be potential gas producers.

Manitoba. Reaching out from the Virden-Roselea field there have been several discoveries at distances great enough to rate as new field wildcats. For the most part development has not as yet proven the extent of the discoveries.

To the west of Ebor field and almost on the Saskatchewan border, oil was found by California Standard at West Butler in 1 of 31, 9-29 W.1.

J. P. Owen found oil near Waskada in 13 of 18, 1-25 W.1, about three miles north of the International Boundary.

British Columbia. Most of the exploration has been in search of gas for the Westcoast pipe line authorized in 1955 to take gas to the Pacific-Northwest. Eleven locations rated as New Field Wildcats found gas and one found oil. Two other rather long step-outs found gas. No development drilling was done during the year.

To the north of the "Peace River Block" and even in parts of it, the country is unsettled, and consequently there are no roads save for the Alaska Highway. There is much muskeg and access for exploration has been by following rivers or aerial reconnaissance. Trails have been cleared by bulldozers in winter and each well location has involved a major engineering effort of getting equipment and supplies to the site. Consequently there is much country to be explored below the surface as well as much country that, save for maps prepared from air photos, is virgin surface land. A large oil producer from the Granite Wash, completed early in 1956 in northwestern Alberta (Union Red Earth 12 of 17, 87-8 W.5) went only to 4,797 feet, with production 4,744-80 and it has fired the hopes of numerous companies with a big resulting land play which will doubtless extend over much of the British Columbia area east of the Rockies. It would seem probable that even a good sized discovery may need to wait some time for a market outlet in view of the distances involved and the terrain to be traversed by a pipeline.

Aside from this northeast corner of British Columbia, there are sedimentary deposits in some of the intermountain valleys and in 1955 three dry holes were put down in the Okanagan Valley, the deepest going to 2,152 feet.

Coast deposits of sediments are fairly thick and by analogy with California oil fields in the same geological province there is always the hope that they may prove productive although to date no more than signs of gas have been encountered in rather sparse drilling operations. In 1955 a dry hole in the Vancouver area went to 6,044 feet.

Parts of Vancouver Island have sedimentary deposits and coal has for some years been mined at Nanaimo. The Queen Charlotte Islands also have sedimentary deposits and in 1950 a well was drilled on Graham Island in that group to a depth of 3,512 feet. It started in beds of probable Cretaceous age, penetrated Jurassic-Triassic beds and reached crystalline rocks at total depth.

Northwest Territories. One well located on surface geology found gas at Rabbit Lake. Five wildcats were dry. While the gas discovery is at present far from any commercial outlet, it is the first discovery in Northwest Territories since Norman Wells in 1920.

Important Dry Hole Exploration. In British Columbia two tests went to the basement, in Alberta eight tests went to the basement or very close to it, in Saskatchewan three tests went to the Pre-Cambrian and in Manitoba, one went to the Pre-Cambrian.

While these deep tests were unproductive of oil or gas, they become important in unraveling the geologic history of the Plains and can be looked to in the search for pinch-outs and in assessing the potential sediments that may contain oil and gas. In addition the potash exploration should aid in appraising the potential yield of this material.

Oil Reserves. Estimates by a committee of the industry using API rules put oil reserves at about 2.4 billion barrels as at the end of 1954 and 2.76 barrels at the close of 1955. It should be noted that API rules do not bring into account undrilled acreage more than one location out from where drilling has gone. Such fields as Pembina, where a much larger area appears actually proven, are thus underestimated.

Potential Production and Markets. Potential production has been increasing very rapidly and while markets are also increasing there is a rather rapid widening of the gap, with resulting restriction of production. During the year increased refining capacity has been built in Canada and also in United States localities where Canadian oil has become available as in the Puget Sound area and near Minneapolis. Early in 1956, Imperial Oil announced increased capacity for the products pipe lines from Sarnia to Toronto will be built, and some Canadian oil is going to Michigan refineries. Conditions for putting western oil into Montreal do not yet appear favorable, so that imports from Venezuela and from the Persian Gulf still serve that large refining center.

In 1927 western Canada managed to produce a little over 300,000 barrels of oil in the year. In 1955 Alberta alone averaged about 310,000 barrels daily while Saskatchewan produced over 30,000 and Manitoba some 3,360 barrels daily. In early 1956, nominations for Alberta alone exceeded 400,000 barrels daily. Consequently there was much to console operators even though new wells are constantly claiming their share of the market.

Development Drilling. Fields in which ten or more producers were completed during the year are tabulated below and the figures do not include wells in the exploratory category in the fields concerned.

Alberta	*Oil*	*Gas*	*Dry*	*S.W.D.*
Battle South	11	–	4	
Bonnie Glen	12	–	2	
Drumheller West	15	–	1	
Erskine	20	1	1	
Fenn-Big Valley	33	–	3	
Joffre	135	1	3	
Lloydminster	23	1	1	1
Pembina	626	–	1	
Sturgeon Lake South	33	–	–	
Sundre	10	–	–	
Wainwright	38	1	2	1
Saskatchewan				
Alida	19	–	1	1
Battrum	28	–	8	
Cantuar	69	–	4	
Coleville	78	–	1	
Dewar-Smiley	19	–	1	1
Dollard	17	–	4	
Eureka	36	–	2	
Frobisher	13	–	–	
Gull Lake	14	–	1	
Lloydminster	33	1	8	1
Midale	49	–	–	
Nottingham	41	–	2	
South Success	15	–	–	
Steelman	31	–	–	
Manitoba				
Daly	39	–	4	6
Maples	12	–	–	1
Virden-Roselea	82	–	5	4
Virden North	93	–	3	

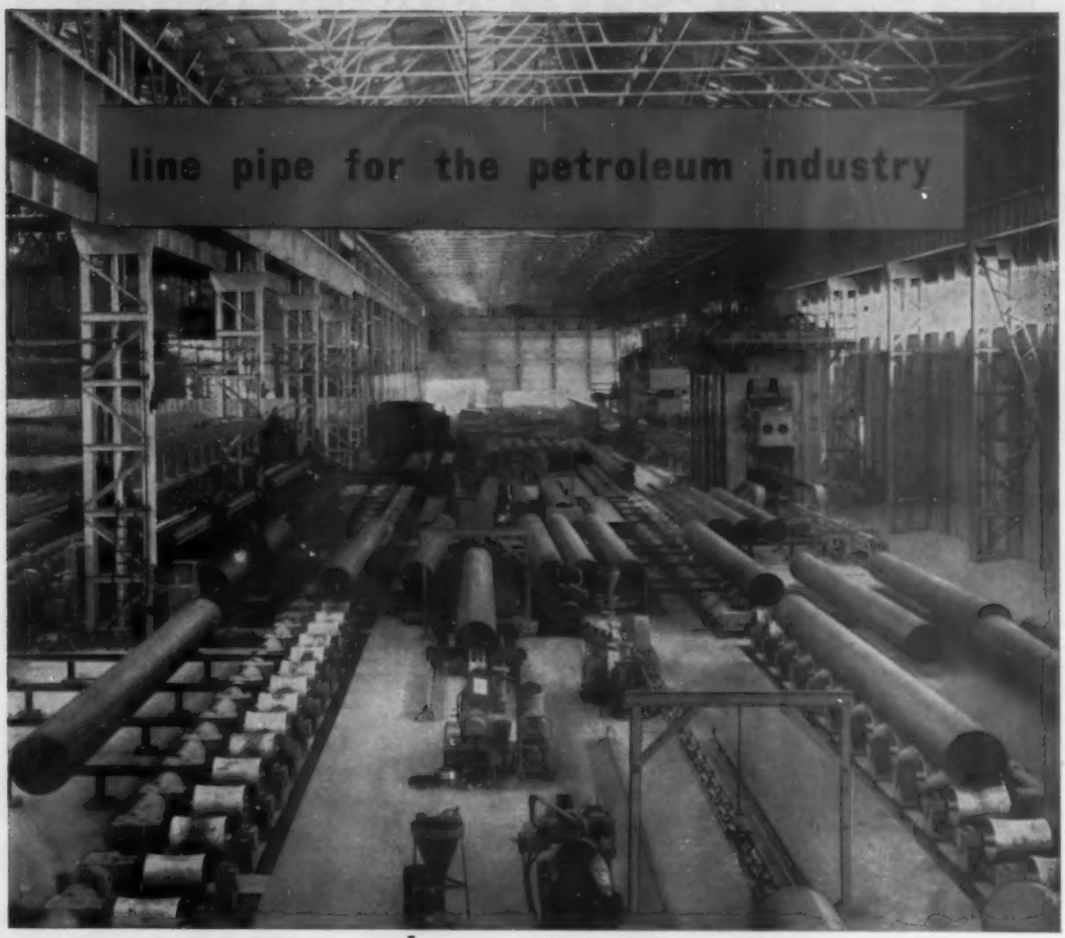


Illustration shows the manufacture of 30 inch diameter steel pipes for the Westcoast Transmission Company Ltd.

from the new South Durham Steel Pipe Mill, Stockton-on-Tees, England

Part of the new Steel Pipe Plant at South Durham's Stockton Works. Brought into commercial production in July, 1955 this plant, the only one of its kind in the United Kingdom and Western Europe, is designed for the fast, economical production of high quality line pipe to A.P.I specification in diameters from 16 inches to 40 inches, plate thicknesses from $\frac{1}{4}$ inch up to $\frac{5}{8}$ inches and lengths up to 40 feet.

Full details and information on application

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Large net income gains were shown by leading Canadian oil companies during 1955. Expectations for 1956 are also high, based on continuation of the current growth rate in domestic oil demand and large exports to the United States.

1955 Financial Review of Canadian Oil Companies

DURING 1955 the average rise in net earnings of major oil companies reviewed was about 23%. This excludes some of the major companies, including those which expanded mostly through acquisition of other concerns, such as Petrofina and Canadian Oil Companies. For the latter two the increase in net income averaged about 50%.

The over all increase of 11% in Canadian oil demand during 1955 was partially responsible for the high level of earnings. An even larger factor, however, was the unprecedented export demand, which for 1955 reached 50,000 b/d in crude and 3,000 b/d in products. This export demand was up to 100,000 b/d for crude at the end of the year, and the outlook for 1956 is bright, based on developments to date.

Imperial Oil Limited—Imperial, one of Canada's leading companies, experienced a record year in crude oil production, refining and sales which increased their net earnings in 1955 to $2.08 per share, compared with $1.66 per share in 1954. Sales went up 15%.

Gross income was $700 million, 14% higher than 1954. After paying $594 million expenses and allowing $44 million for income taxes, the company had net income of $62,145,140 or $8.87 for each dollar of gross income, compared with $8.07 the year before. New facilities built in 1955 cost $80 million. Total assets, after depreciation were $701 million at year end, up $112 million over 1954.

Gross production of crude by Imperial was over 39 million barrels, an increase of 12% over 1954.

IMPERIAL OIL LTD. AND SUBSIDIARY COMPANIES

Operating and Financial Results

FINANCIAL	1955	1954
Gross income	$700,275,343	$614,549,613
Expenses	593,809,630	528,066,996
Income taxes on earnings	44,320,573	36,900,032
Earnings after income taxes	62,145,140	49,582,585
Per share	2.08	1.66
Dividends paid		
Per share	.95	.90
OPERATING (Barrels per day)		
Gross* crude oil production	108,091	96,533
Net* crude oil production	93,319	83,634
Crude oil processed at refineries	239,137	214,383
% Canadian crude	67	58
Crude oil & product imports	107,929	88,268
Product sales	250,085	217,932

* Gross production includes and net production excludes royalties and oil payments due others on Company's share of production.

Canadian Oil Companies, Limited—Net profits of Canadian Oil Companies rose from $1,845,000 in 1954 to $2,806,000 in 1955. Net profit per common share dropped slightly however, from $1.38 in 1954 to $1.30 in 1955, due to the increase in the number of shares from 1,009,960 to 1,805,553. The increase was due to the acquisition of the assets of Anglo-Canadian Oil Company Ltd. The basic figures on the company's 1955 performance, with comparison with 1954, are as follows:

CANADIAN OIL COMPANIES, LIMITED

FINANCIAL (Thousands)	1955	1954
Sales	$66,197	$58,518
Net profit on operations	2,806	1,845
Net profit per common share	1.30	1.38
Dividends per common share	.575	.50
Working capital	17,767	8,906
Total assets	91,568	62,169
Capital expenditures	25,249	3,100
Depreciation, etc.	4,381	3,505
Taxes on income	2,083	1,690
OPERATING (Thousands)		
Refinery crude run—barrels	7,362	6,663
Sales—barrels	8,978	7,780
Payrolls & employee benefits	5,757	5,463

British American Oil Company Limited—British American experienced a record year in 1955. Gross income was $271,066,000, up 11% and consolidated net profit for 1955 was $20,613,000 an increase of 13.5% over the $18,159,000 of 1954. Earnings per share increased from $2.16 in 1954 to $2.27. Canadian earnings at $13,577,000 were up 23.6% U. S. earnings at $7,036,000 showed a decline of 1.8%, due to higher charges for exploration expenses offsetting the benefit of an 11% increase in crude oil production.

British American's 1955 production of crude oil at 10,495,000 barrels reached a new high with substantial increases both in Canada and the U. S. Reserves at the end of the year stood at 113,000,000 barrels of crude oil and 404 billion cubic feet of gas.

Capital expenditures in 1955 aggregated $37,240,000, up nearly $4,000,000 from 1954.

BRITISH AMERICAN FIGURES FOR 1955 AND 1954

FINANCIAL	1955	1954
Gross Income	$271,066,065	$243,849,044
Purchased crude oil, products & freight	146,225,653	132,800,938
Operating & administrative freight	61,382,890	54,820.409
Taxes other than taxes on income	13,516,485	12,425,886
Depreciation & depletion	15,461,754	13,707,009
Income taxes	12,388,00	10,420,000
Net profit	20,613,219	18,159,114
Dividends	7,575,909	6,759,348
Working capital	60,636,633	58,276,550
Total assets	263,284,684	243,406,913
Shareholders' equity	181,881,034	152,710,636
OPERATING (Barrels)		
Net crude oil production	10,495,000	9,283,000
Crude oil processed	35,676,000	33,313,000
Sales of refined products	33,875,000	29,972,000

McColl-Frontenac Oil Company Limited—McColl-Frontenac and its subsidiary companies likewise experienced a good year in 1955 with a rise in consolidated net income to $10,283,094, equal to $3.85 per common share. This compares with $7,940,283 or $2.95 per common share in 1954. About 34 cents of the 1955 increase is due to non-recurring profit items occurring through sale of 10% of the company's share in the Montreal-Portland Pipe Line system.

Cash dividends paid on common stock in 1955 totaled $1.20 per share, compared with $1.00 in 1954. Capital expenditures in 1955 were $11,233,468, compared with $12,638,473 in 1954.

Production by the company in Western Canada rose to 1,708,444 barrels in 1955, compared with 1,303,953 barrels in 1954. Net crude production in Trinidad totalled 1,169,612 barrels, compared with 1,149,301 barrels in 1954. Exploration of undeveloped areas in Trinidad is financed by an arrangement with The Texas Company under an agreement providing for repayment only in oil produced in those areas, such advances totaling $3,193,778 at the end of 1955.

Sales of petroleum products totalled 17,073,584 barrels, up 18% over 1954 levels. A new office building was completed in Montreal during 1955.

(*Continued on page* 210)

DOMINION TILTING DISC CHECK VALVES

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DOMINION ENGINEERING
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MONTREAL TORONTO WINNIPEG VANCOUVER

Geophysical activity during 1955 showed a slight increase. Generally it was due to activity in Manitoba, British Columbia and Northwest Territory. Activity in these areas, especially British Columbia, will probably continue to increase during 1956, due to the recent encouraging results of exploration.

Geophysical activity in WESTERN CANADA—1955

Ploughing through gumbo in northern Alberta is a tractor which oilmen hope will answer the transport problems in exploration work in the Lesser Slave Lake area. The new machine is reportedly successful in this type of country. Lorne Thompkins, superintendent of mechanical equipment for Bear Oil Co. (left) and his assistant put their new tractor to a stiff test in muskeg country.

THE decline of geophysical activity in Western Canada was reversed during 1955. The total of activity rose slightly to 1,598.5 party months, compared with 1,590 in 1954. This is still below the record peak of 2,042 in 1952.

A total of 1,495.5 party months of seismic work was performed during 1955, compared with 1,493 during 1954. Gravity crew activity showed a slightly stronger rise, from 97 in 1954 to 103 in 1955.

Among the provinces, Alberta received the largest amount of seismograph crew months, with a total of 993.5 (See Table I). This is lower than in 1954, however, when 1,085 crew months were put in. Gravity activity in Alberta rose over the year to 83 party months, compared with 65 during 1954.

Saskatchewan lost ground during the year, with a decline in seismic activity to 280.5 seismic party months from 304 in 1954. Gravity work also declined, to 14 party months in 1955 compared with 24 in 1954.

Manitoba, British Columbia and the Northwest Territory all showed increase in activity during the year and contributed the net increase that was shown in geophysical activity for Western Canada.

Manitoba increased its hours of seismic work eight fold, to 24 party months in 1955 from three in 1954. Gravity work in the province declined, however, from eight party months in 1954 to three in 1955.

British Columbia showed the largest absolute increase in seismic party months to 167.5 in 1955, compared with 97 in 1954. Gravity work in the province also increased, to three party months in 1955 from none in 1954.

Northwest Territory had no gravity work during 1955, but showed an increase of nearly eight times in seismic work, to 30 party months in 1955 from four in 1954.

The usual seasonal fluctuation was shown in geophysical activity (see Table II). From a low reached during the early spring of 105 party months in April, activity rose slowly to 112.5 party months in May. Real activity did not begin until November, when party months rose to 140.5 and then to 172 in December. Operations in the muskeg country cannot begin full scale until the freeze sets in, due to transportation difficulties. Some of this difficulty has been conquered by the use of helicopters and special tracked units, but the familiar "Road Closed" signs appearing in the spring still herald a decrease in party activity.

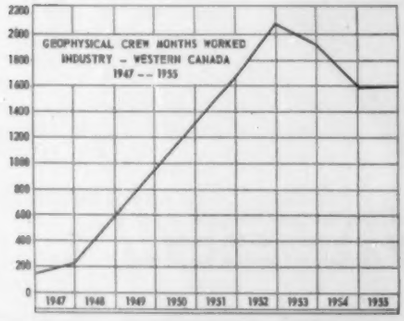

TABLE II

Average Number Crews—1955—Western Canada

	Seismic	Gravity	Magnetometer	Total
January	135	8	—	143.0
February	145.5	13	—	158.5
March	149.5	11	—	160.5
April	99.5	6	—	105.5
May	106.5	6	—	112.5
June	110	10	—	120.0
July	111	8	—	119.0
August	112	8	—	120.0
September	111	8	—	119.0
October	119	8	—	127.0
November	131.5	9	—	140.5
December	164	8	—	172.0
	1494.5	103	—	1597.5

TABLE I

*1955 Geophysical Activity—Crew Months—Western Canada**

	Seismic			Gravity			Magnetometer			Total		
	1955	1954	1947	1955	1954	1947	1955	1954	1947	1955	1954	1947
Alberta	993.5	1085	155	83	65	41	—	—	7	1076.5	1150	203
Saskatchewan	280.5	304	—	14	24	—	—	—	—	294.5	328	—
Manitoba	24	3	6	3	8	—	—	—	—	27	11	6
British Columbia	167.5	97	—	3	—	—	—	—	—	170.5	97	—
Northwest Territory	30	4	—	—	—	—	—	—	—	30	4	—
	1495.5	1493	161	103	97	41	—	—	7	1598.5	1590	209

*Source: Crew months data for this tabulation and Figures 1 and 2 were obtained from the Committee on Geophysical Activity of the Society of Exploration Geophysicists for the years 1947 and 1955. Figure 1 is reproduced through the courtesy of the editors of GEOPHYSICS

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Shell Oil Company of Canada

(*Continued from page 63*)

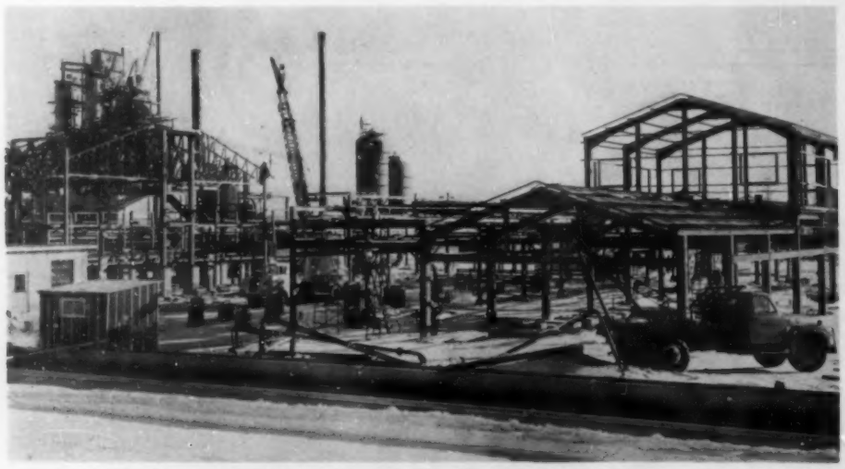
A major expansion program is now in full swing at Shell's Montreal East Refinery. The new facilities are designed to boost throughput to 55,000 b/d—an increase of 10,000 b/d. In addition, the refinery, which up to now has been processing low sulfur Venezuelan crudes, is being equipped to allow running high sulfur crude for half of its intake.

The expansion schedule may be broken down into three distinct phases as follows:

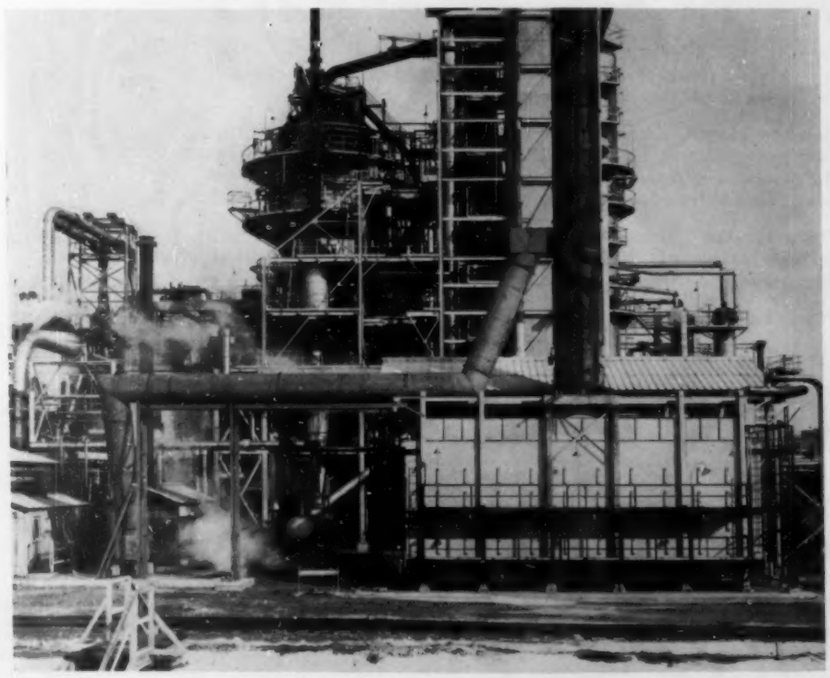
1. Expansion of catalytic cracking, gas recovery and of feed preparation facilities.
2. Expansion of crude distilling capacity.
3. Installation of facilities to enable the processing of sour crude.

The first of these phases was completed in January with the commissioning of a new vacuum flashing unit. Expansion of the catalytic cracking and gas recovery facilities was carried out last October.

Designed along similar lines to the original unit, the new flasher will process 13,000 b/d of straight run residue. The provision of a new unit has two advantages over expansion of the original unit to handle the increased capacity. First, it permits complete segregation of high and low sulfur stocks and second, a better yield of catalytic cracking feed stock is attainable from two units operating at lower throughputs.



Platformer and desulfurizer under construction by Shell Oil Company at Montreal.



Catalytic cracking unit showing new preheat furnace at Shell Oil Company's Montreal refinery.

The catalytic cracking unit built in 1951 was a heat balanced unit with capacity rated at 10,000 b/d fresh feed. Prior to last year's expansion, feed rates as high as 16,500 b/d had been maintained but the unit suffered from limitations in catalyst circulation rate and regenerator air capacity. Increasing catalyst circulation would have involved major structural changes. Expansion design was based therefore on increasing fresh feed rates to 19,500 b/d at a much lower catalyst/oil ratio. To maintain heat balance a 70 mm Btu/hr. feed preheat furnace was provided and a new type of internal regenerator cooler of 38 mm Btu/hr. design capacity.

This cooler takes the form of eleven pairs of semicircular bayonet type steam generating coils with internal water feed pipes extending to the far end of the coil. A feed water circulation ratio of 5.1 is provided. Steam is generated at 225 psig. The cooling load is changed stepwise according to requirements by cutting coils in and out. Intermediate cooling loads are obtained by adjustment of other operating variables as formerly.

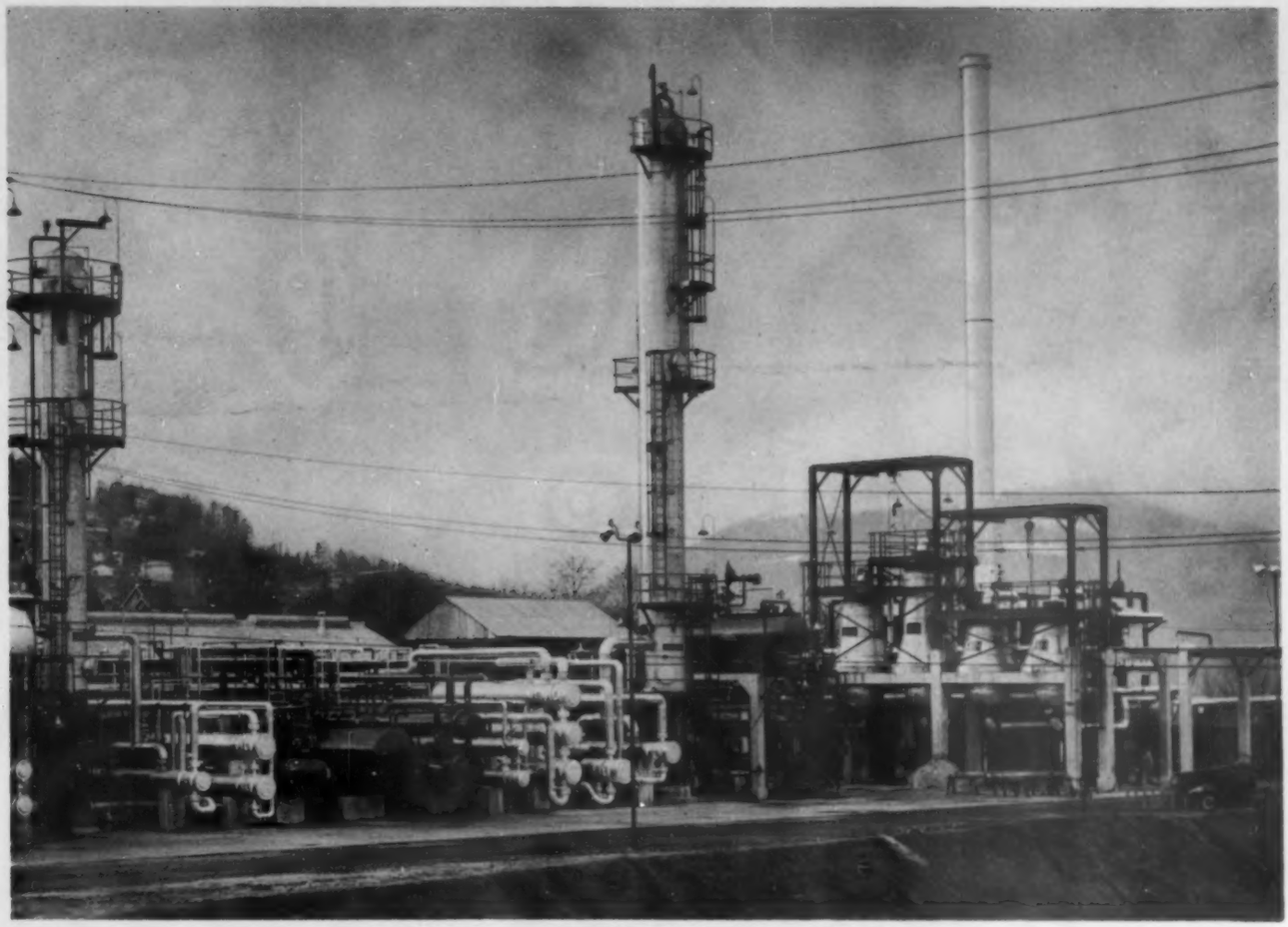
To keep reactor superficial velocity as low as practical, the operating pressure of the system was raised about 3 psig. This, together with the higher coke make expected at maximum throughput, made it necessary to install an additional regenerator air blower. The new unit was designed to operate in parallel with the original blower with its own independent speed and air output controls.

Extensive revisions were also carried out to the main cracked products fractionator and gas recovery plant columns. The extra capacity required was obtained in all cases by replacement of the original bubble cap trays with Shell flat bar type turbo-grid trays. A total of 170 trays were replaced in six columns varying from three to ten feet in diameter.

Phase 2 of the expansion program involving an increase in crude distilling capacity is scheduled for completion in June. Crude is at present distilled on two units of capacities 15,000 b/d and 30,000 b/d. The smaller unit, part of the original refinery built in 1932, was designed for 5,000 b/d. This unit will be retired and a new 25,000 b/d unit is under construction. Much of the existing equipment will, however, be reused in the new plant the principal additions being a new 110-ft. secondary column and preheat furnace.

Phase 3 of the expansion program involves entirely new facilities which will enable the refinery to process sour crudes. Construction is now underway with completion scheduled for mid-year.

A Platformer will have a capacity of 6,600 b/d at 8.1 H_2:oil mol ratio and will process naphthas from both crude distilling units.



Shell's new Platformer at Shellburn refinery in Vancouver, British Columbia.

The hydrogen produced from this operation will be used in a new Shell Trickle Phase Hydrodesulfurization unit designed to process heavy flashed distillate for catalytic cracking feed stock, which will then reduce sulfur content of all catalytic cracking products. The hydrodesulfurization unit will have a capacity of 7,500 b/d intake and will be the first commercial unit of its kind to operate on this type of feedstock.

The Platformer and hydrodesulfurizer will occupy a common process area with a central control room equipped with a graphic panel.

To ensure satisfactory quality of straight run products from sour crude, three additional new treating units are under construction on a site adjacent to the new crude distilling unit. These treaters are of the copper slurry type and will operate on aviation turbine fuel, mineral spirits and light heating fuels.

A review of Shell's Montreal East expansion program would not be complete without some mention of the utility and offsite facilities which accompany the major process unit additions. In the field of utilities two new cooling towers have been added with a combined capacity of 18,000 gpm. Two 60,000 lb/hr. steam boilers are being added together with a new 225 ft. self-supporting concrete stack. Extensive changes and additions have been made to the electrical distribution system to supply the power for the new and expanded plants. Finally tankage for crude and finished products have been added amounting to 650,000 barrels.

To maintain its position as a supplier of top-grade gasolines in Western Canada, Shell has recently completed a 3,800 b/d Platformer at its Shellburn refinery situated on the outskirts of Vancouver, B.C. Basic process design for this plant was furnished by Universal Oil Products Co. and the construction contract was awarded to Procon (Canada) Ltd. early in 1955.

The Platformer feedstock will be a 210-390°F. naphtha cut from sour Alberta crudes. Because of the high sulfur content of the feedstock, the Platformer is provided with a catalytic desulfurization section, which is fully integrated with the Platformer proper. The desulfurization plant employs cobalt molybdenum catalyst which will ensure virtually complete removal of sulfur and other impurities from the feed with subsequent prolongation of the catalyst life. Off-gas from the Platforming section will supply hydrogen for this process.

The purified feed enters the Platformer where it is combined with recycle hydrogen and is charged to the first of three reactors. A single three-cell furnace supplies the preheat for the first reactor and reheat for the second and third reactors. (The reactors are unlined and of low alloy construction with external insulation.)

Control features in this plant include an alarm shutdown system that acts on low feed or low recycle gas flow which serves to protect catalyst and equipment. A graphic control panel keeps operating personnel fully in touch with all aspects of plant operation.

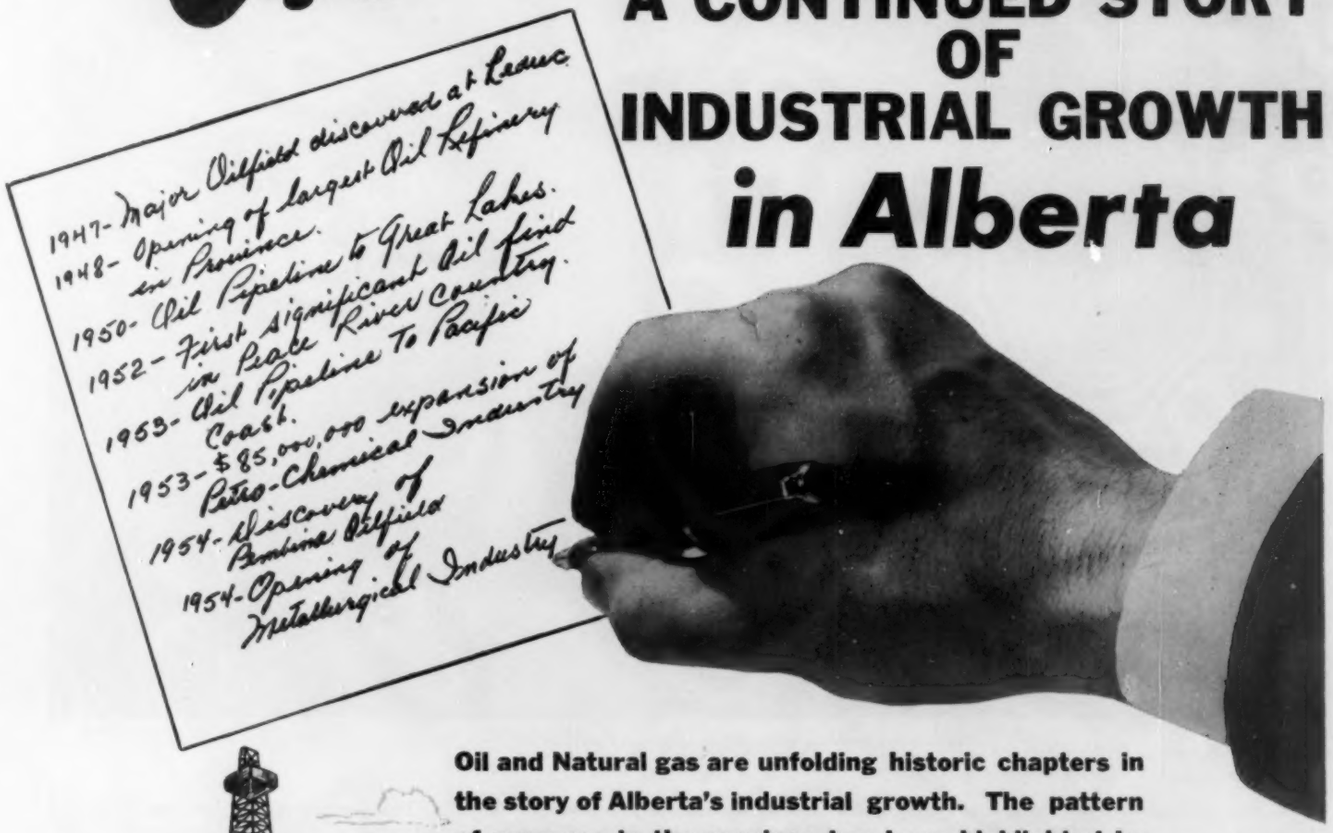
The addition of the Platformer follows hard on the heels of a major revision and expansion program completed in 1954. At that time the crude distillation unit was revised and expanded to process approximately 20,000 b/d of Canadian crudes. Additional new facilities installed at that time included a vacuum flasher, catalytic cracking unit, gas recovery and polymerization units, tankage and auxiliaries.

The expanded refinery as it stands today will produce a full range of gasoline, LPG, naphthas, aviation turbine fuels, distillate fuels, bunker fuels, road asphalts and roofing flux.

(*Continued on page 122*)

OIL WRITES

A CONTINUED STORY OF INDUSTRIAL GROWTH in Alberta


1947- Major Oilfield discovered at Leduc
1948- Opening of largest Oil Refinery in Province.
1950- Oil Pipeline to Great Lakes.
1952- First significant Oil find in Peace River country.
1953- Oil Pipeline To Pacific Coast.
1953- $85,000,000 expansion of Petro-Chemical Industry
1954- Discovery of Pembina Oilfield
1954- Opening of Metallurgical Industry

Oil and Natural gas are unfolding historic chapters in the story of Alberta's industrial growth. The pattern of progress in the province has been highlighted by milestones of oil discovery and development and the subsequent establishing of vast multi-million dollar industrial giants . . . pipelines carrying the lifeblood of industry to distant parts of the continent . . . petrochemical plants performing miracles of 20th century science . . . metal refineries now economically feasible through low-cost processing. Yes, industry continues to grow and grow and grow in Alberta – thanks to oil and natural gas! For pertinent facts on specific industrial inquiries write . . .

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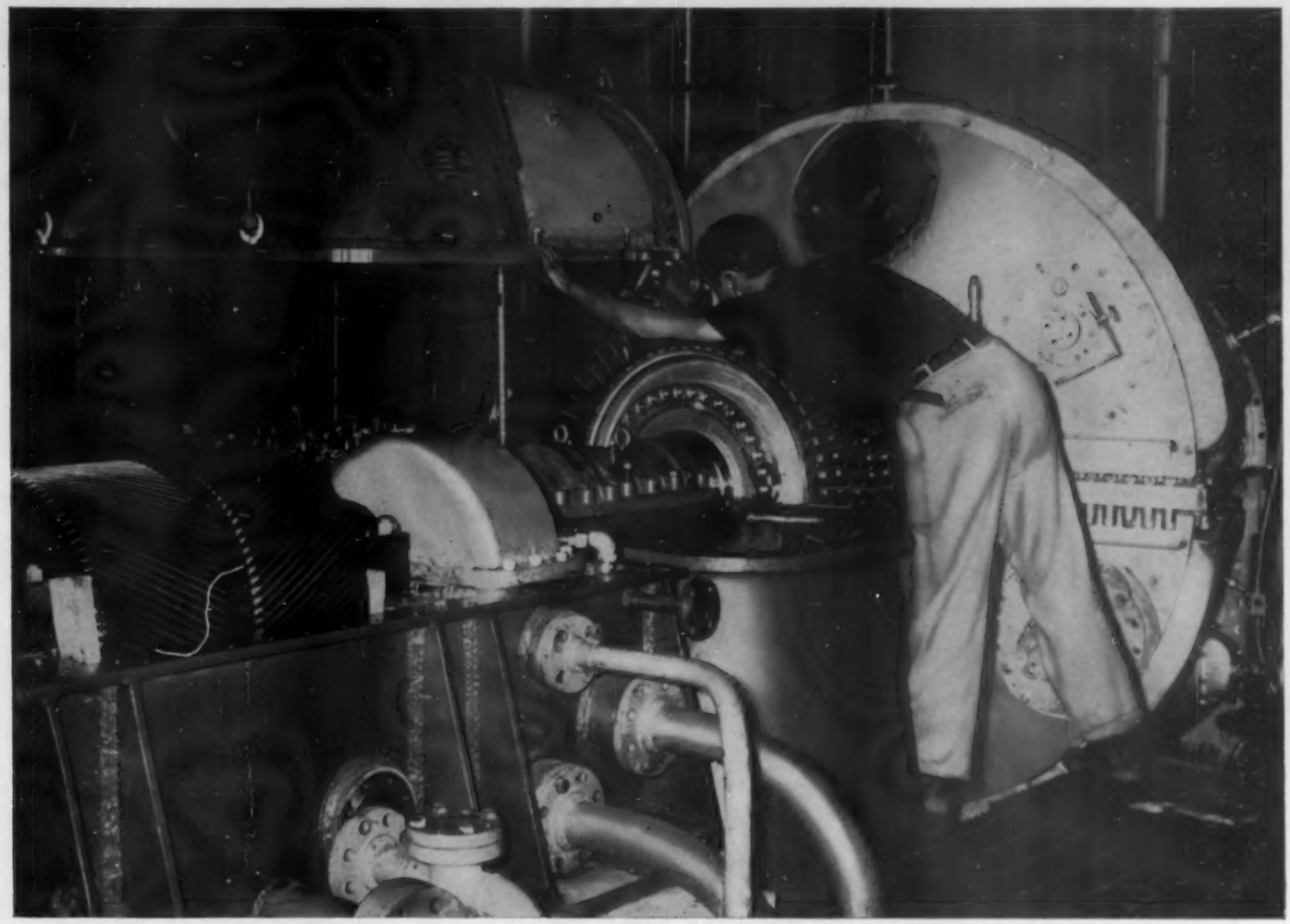


Another Westinghouse Gas Turbine goes on the line

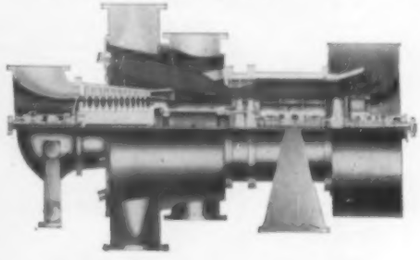
Looking for an easy-to-install prime mover? Or a reliable source of electric power?

In either case you'll find what you need in the new Westinghouse gas turbine. This surprisingly flexible power plant comes in capacities from 1800 hp (1250 kw) to 20,000 hp (15,000 kw). It works on gaseous or distillate liquid fuels, and requires little or no water . . . making it particularly ideal in areas where water is short or gas is plentiful. And its light weight plus vibration-free operation minimize the expense of supporting foundations.

You're in good company when you specify Westinghouse gas turbines for uses such as compressor drive, pipeline pumping, mobile, emergency, or normal power supply. The Mene Grande Oil Company, for example, uses these units . . . one of which is illustrated during installation . . . to convert natural gas into electric power for their eastern Venezuela oil fields. And Creole Petroleum Corporation is harnessing 12 Westinghouse gas turbines to pump natural gas into oil deposits below Lake Maracaibo. This operation forces the oil upwards, enabling Creole to recover substantially more of the "black gold" than with more conventional methods.

If you want more power quickly, find out the facts about Westinghouse gas turbines. Write for free booklets: B-5887 for electric power generation; B-5859 for mechanical drives.

N. F. Emig, Supervisor, Steam Section



Cutaway view of Westinghouse 5000-hp gas turbine. Red area shows path of hot gases from combustion chamber (L.) through power turbine to exhaust (R.). View highlights simple, compact design of turbine.

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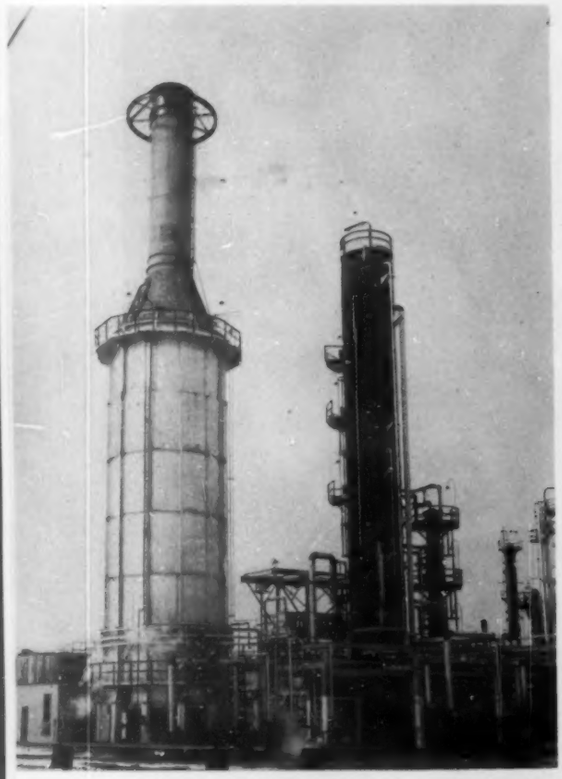
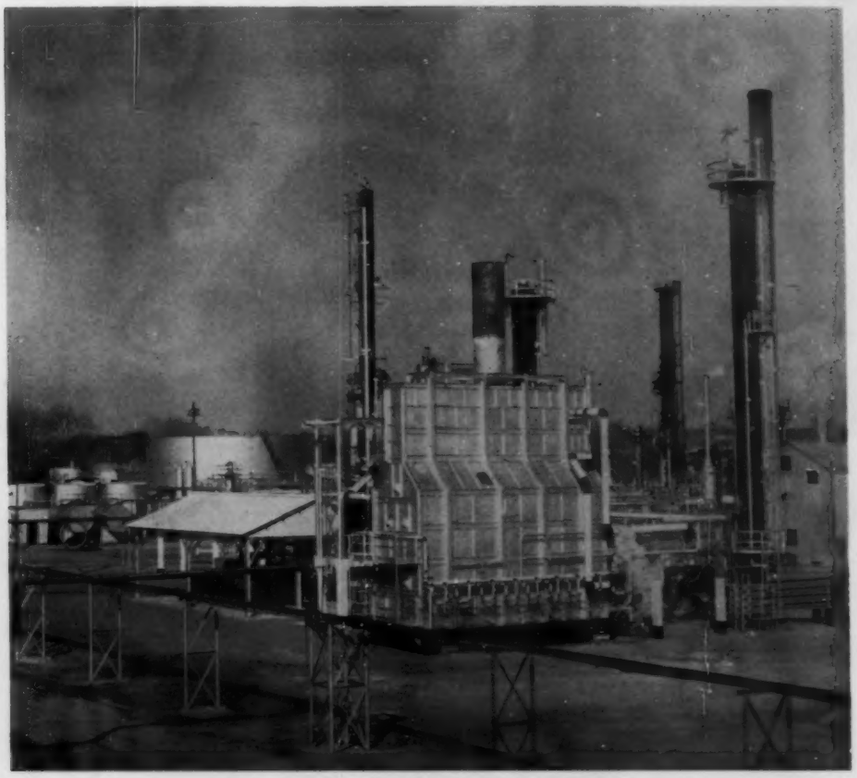


Topping plant of the Port Credit refinery of Regent Refining (Canada) Ltd.



Platformer at the Port Credit refinery of Regent Refining.

Regent Refining (Canada) Limited

(*Continued from page 119*)

In keeping with the rapid expansion of commerce and industry in Ontario, Regent Refining (Canada) Ltd., has embarked upon a further extension and modernization of its refining facilities at Port Credit with an established cost of approximately $7 million. Detailed engineering and purchasing of major equipment is now in hand for construction during 1956 of a new catalytic cracking unit, complete with gas concentration and polymerization, which will allow an increase in crude throughput to 20,000 b/d.

Regent has maintained a steady expansion program at Port Credit, having just finished the installation of new atmospheric distilling facilities, which made possible an increase in crude throughputs from 7,500 to the current 14,000 b/d. In the previous year a UOP Platformer of 2,300 b/d capacity had been constructed.

The new expansion now in hand is being engineered by Universal Oil Products Co., and construction will be undertaken by Procon (Canada) Ltd. The catalytic cracking unit is a stacked design having a coke burning capacity of approximately 10,000 lb/hr, which will be equivalent to a throughput of approximately 7,500 b/d of heavy vacuum gas oils derived from Trinidad and western Canadian crudes. The feed preparation step for this unit will consist of a new vacuum section which will be built as an integral part of our current distilling facilities.

The catalytic cracking plant will have a completely new gas concentration system and a phosphoric acid polymerization unit for the processing of the C-3 and C-4 cuts. This plant will also turn out a commercial LPGas and will be complete with storage and handling facilities. This new plant will be of completely modern construction using, for instance, electronic instrumentation throughout and the air blower and gas compressors will be driven by electric motors taking their power from the local Ontario Hydro Electric System. Other prime movers will be electric or steam, arranged to satisfy the exhaust steam requirements for the refinery area.

The extension of refining facilities at Port Credit has also necessitated the extension of docking facilities and crude tankage and handling equipment for both crude and products. The first essential item on this work was the building of an additional crib for docking large tankers up to 15,000 tons capacity and the installation of new loading and unloading lines to reduce laytime of all vessels.

It was also necessary to rebuild and extend Regent's road tank wagon fleet and loading facilities. A new loading rack is expected to be finished by June and will allow for efficient and rapid loading of all types of road tank wagons up to 5,400 I.G. capacity.

In keeping with the increase in business, an enlarged sales program has been put in hand, which includes the building of many new service stations in Ontario and Quebec, as well as the necessary terminals for economical product distribution by water or road transport. This expansion also necessitated extension of lubricating oils and greases distributing facilities; therefore, a new modern canning, packaging and warehousing plant is being constructed. An attempt has been made in this plant to have the most modern equipment and plant design to reduce handling time and simplify the distribution of these products as much as possible.

The crude supplies for this refinery are all brought to Port Credit by water transport. About half of the charging stock will be western Canadian crude trans-shipped from the pipe line terminal at Superior, Wisconsin to Port Credit in large tankers. The remaining crude supply is imported from Trinidad, B.W.I. by deep sea tanker to Montreal and is trans-shipped to Port Credit in small river tankers. Regent is looking forward to the opening of the new St. Lawrence deep waterway, which would then allow crude oil to move into Toronto in much larger vessels.

British American Oil Co., Ltd.

British American Oil Co., Ltd., processed 32,320,000 barrels of crude at its five refineries in 1955, the highest in the history of the company. In the past five years, throughput per stream day has been increased by 75%, from 56,000 to 98,000 b/d.

Crude capacity is to be further augmented by addition to the Clarkson plant in 1957 of a topping and vacuum unit to process 30,000 b/sd. This will more than double existing Clarkson crude facilities.

Along with the steadily increasing quantity demand, there has also been a corresponding requirement for higher quality petroleum products. BA's Calgary refinery, with topping and thermal cracking facilities only, had been finding it difficult to produce gasolines of the required octane level with a reasonable quantity of TEL. In February 1955 an Atlantic type catalytic reforming unit (Catformer) went on stream at this location. Engineering and construction were handled by the Fluor Corp. of Canada Limited.

The Catformer, together with the stabilizer section and amine treating unit, is designed to process 2,000 b/sd of total straight run gasoline from a mixture of light and heavy Western Canadian crude oils. Provision has been made to process up to 25% of a thermally cracked naphtha. The straight-run naphtha charge has a 360°F, final boiling point with a research octane of 55. The Catformer has been operated this past year to an 80 clear octane debutanized reformate at a yield of 95%.

British American completed a catalytic reformer early in February 1956 at the Montreal East refinery. This Catformer was engineered and built by the Lummus Co. of Canada Ltd.

It was designed for a reactor charge of 13,000 b/sd of a 175 to 370°F boiling range naphtha. The installation includes a prefractionation section to prepare the reactor feed from a full range 360 E.P. naphtha amounting to 15,550 b/sd obtained from medium gravity Eastern Venezuelan crudes.

The unit has been designed to give a yield of 88.9 volume percent of the reactor charge, when a 90 F1 clear octane number debutanized Catformate is produced. This operation can be carried out with three reactors. When a 95 octane number reformate is required, provision has been made to add another heater and reactor.

Since this unit was contracted for, B-A has obtained and will be obtaining part of its crude supply from Middle East sources with a higher sulfur content. Consequently, a catalytic desulfurization unit is to be installed by Lummus to desulfurize the 15,550 b/sd of naphtha before it goes to the reformer. This unit circulates a hydrogen-rich gas from the reformer and the naphtha through a single reactor. The cobalt molybdate in the reactor catalyzes the reaction of the sulfur in the naphtha with the hydrogen to form H_2S which is removed in a stripper. The desulfurized naphtha then proceeds to the prefractionator of the cat. reformer.

Offsite facilities provided for this installation were: 1. Relocation and changes in one of the refinery flare stacks; 2. A cooling tower and water pumping facilities to circulate 3,900 gpm (U.S.); 3. Electrical sub-station facilities.

A contract for the engineering and construction of a desulfurization unit and an Atlantic type catalytic reformer at the Clarkson refinery has been awarded to the Lummus Co. of Canada, Ltd.

This desulfurization unit has been designed to handle 12,000 b/sd of a 400°F endpoint naphtha from Western Canadian crudes. The reforming unit includes a prefractionator to prepare a 170 to 400°F boiling range product (depentanized) or as an alternate a 237 to 400°F boiling range (dehexanized) product as feed to the reactors.

The depentanized feed amounting to 10,250 b/sd is reformed in the Catformer to a design yield of 83% debutanized reformate of 90 F1 clear octane.

Provision has been made to split the reformate into a light (275°F endpoint) and heavy reformate. In this way various blends with other light and heavy gasoline streams will enable maximum octane to be attained on the finished motor gasolines.

Offsite facilities to be included in this project are: 1. New cooling water intake at the lake and distribution system; 2. Expanded electrical distribution facilities.

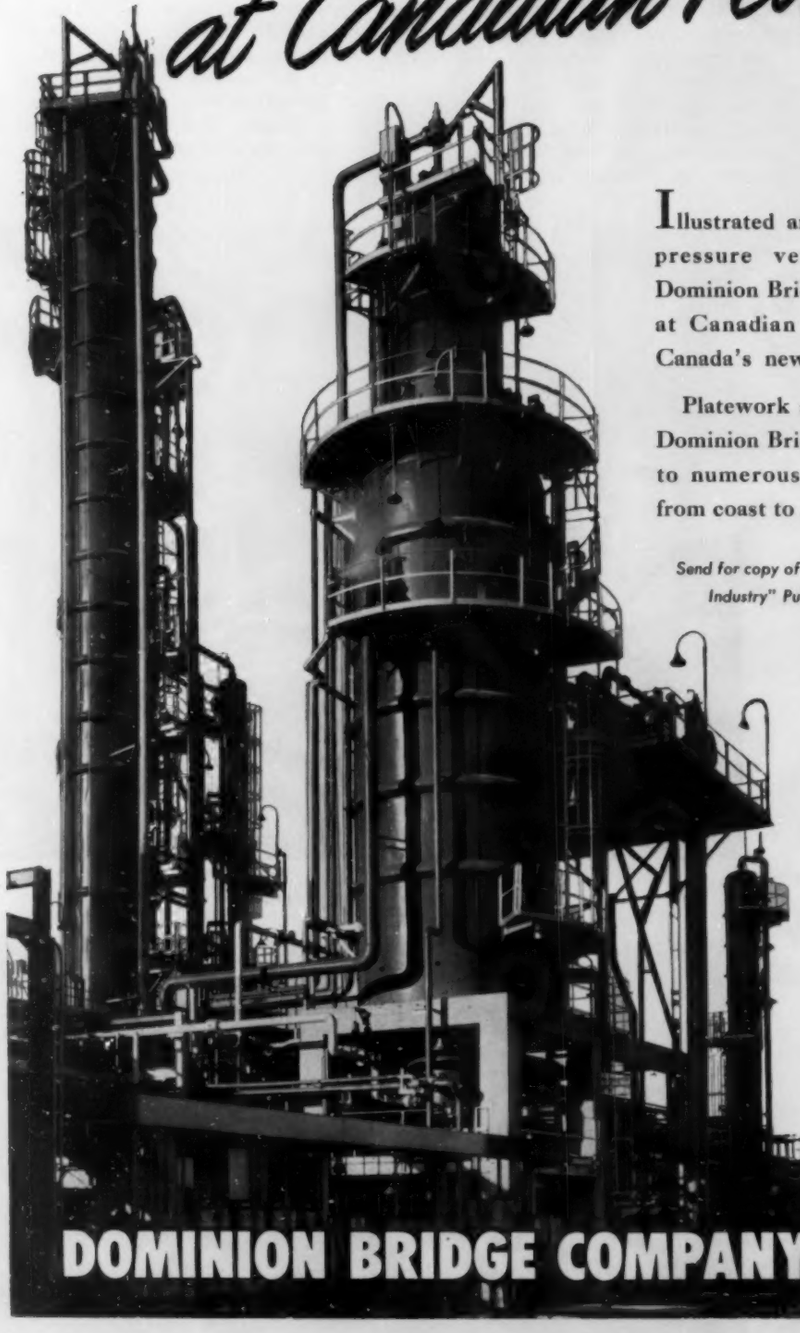
Canada's first mass spectrometer has been installed at B-A's Montreal East re-

(*Continued on page 126*)

Catalytic cracking unit at British American Oil Company's Montreal East refinery. (Photo courtesy of British American Oil Co. Ltd.)

$60,000 mass spectrometer recently installed at B-A's Montreal East refinery. (Photo courtesy of British American Oil Co. Ltd.)

DOMINION BRIDGE
at Canadian Petrofina



Illustrated are two of many large pressure vessels fabricated by Dominion Bridge and now in service at Canadian Petrofina Limited—Canada's newest refinery.

Platework and structural steel by Dominion Bridge have been supplied to numerous Canadian refineries from coast to coast.

Send for copy of booklet "Platework for Every Industry" Publication No. PS-100

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Partial view of the new Canadian Petrofina refinery at Pointe-aux trembles, Montreal.

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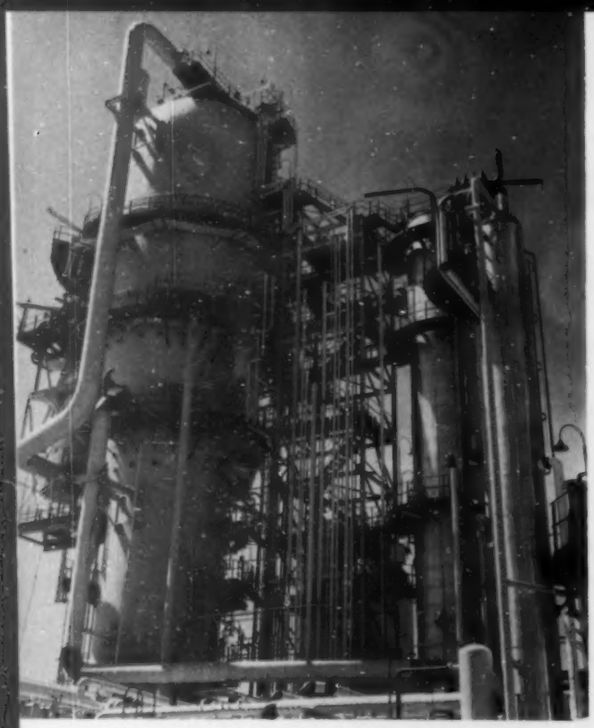


Orthoflow catalytic cracking unit, first of its kind in the world, at Clarkson, Ontario, refinery of The British American Oil Co. Ltd.

(*Continued from page 123*)

finery. Through its use, B-A is confident of devising formulae for a greater variety of petroleum products of a quality and efficiency impossible, prior to the introduction of the mass spectrometer into manufacturing techniques.

Consolidated Engineering Corp. installed the unit. Twenty separate chassis are inter-connected to form the basic electronic control of this instrument. There are 113 vacuum tubes included in the complex circuitry.

The vacuum required to operate this instrument is approximately one ten millionth of a millimeter of mercury. To attain this vacuum, three to four days of continuous pumping by five pumps are required. In addition, two traps are included in the pump lines, one as a dry ice trap and the other liquid nitrogen. Once started the instrument is left on standby operation around the clock.

The scope of the instrument is broad, being limited by sample volatility and computational complexity. All components to be analyzed must exert sufficient vapor pressure at room temperature to provide a vapor phase sample at 50 microns absolute pressure. If samples having lower vapor pressure (high mass) must be analyzed, modifications have to be made consisting usually of a heated oven and related accessories.

The normal mass range (molecular weight) of the instrument is from two to approximately 200.

Oil refinery streams containing up to twenty components can be analyzed. These are analyzed for methane, ethane, and propane (paraffins and olefins) normal and iso-butane, butene, normal and iso-pentane, pentenes, traces of hexane, hydrogen, nitrogen, oxygen, carbon dioxide, carbon monoxide, hydrogen sulfide and air.

Mixtures which are suitable for mass spectrometer analyzes can be divided into two classes:

1. Those hydrocarbon mixtures which can be analyzed directly with no preliminary treatment.

2. Those gas or liquid mixtures which first must be subjected to low or high temperature fractionation.

In most cases fractionation is performed in order to reduce the number of compounds, thereby enabling complex mixtures to be mathematically resolved.

Computational methods are an important factor in the use of the spectrometer. A sample can be run and the record developed in less than half an hour, whereas its computation may be quite time-consuming (from 30 minutes up to a day) depending on its complexity. A considerable investment in manpower and materials is usually necessary before a new group of compounds may be analyzed on a routine basis. Each group has its own operational and computational details which have to be investigated before the instrument can be released from routine analysis.

A CO Boiler is being built for B-A's Montreal refinery, to provide additional steam needed at this refinery. The unit, to be installed by the Babcock and Wilcox Co., will be capable of supplying 165,000 lb/hr at future conditions of 800 psig, 680°F total temperature; it will be operated initially to generate 150,000 lb/hr at the refinery system pressure of 175 psig, 100° superheat. This is an increase of 65% over the present capacity to meet planned expansion and existing winter shortage.

Recoverable energy from the waste gases of catalytic cracking units consists of a sensible heat, plus the heat of combustion of the various constituents discharged by the regenerator. These have been formed by the partial oxidation of coke deposited on the catalyst during the cracking reaction. The heat of combustion of CO to CO_2 is approximately 2/3 of the heat of combustion of carbon to CO_2. Therefore, although the CO concentrations in cracking unit gases are not high, 4% to 6% by volume, the values recovered in this instance represent a pay-out period on the investment estimated conservatively at three years.

Supplementary fuel oil or refinery fuel gas is fired in the primary combustion chamber. CO gas is injected through 12 tangential inlet ports, symmetrically located with six ports at two different levels. Six auxiliary fuel burners are symmetrically located with three burners at each of two levels. The top level of burners is located above the top level of CO ports so that the CO-bearing gas passes through a strata of fire as it leaves the primary furnace. With this arrangement, steam may be produced from two fuel inputs: (1) 1/3 supplied by the flue gas with the remaining 2/3 supplied by the supplementary fuels, or, (2) the boiler may be operated independently of the cracking process, generating full steam capacity on supplementary fuel alone.

The CO unit is essentially a single pass pressurized cylindrically shaped vertical boiler with an elongated water cooled combustion chamber. A pendant type multiple tube single pass superheater and a steel tube economizer are incorporated in the design. All boiler parts are supported by four 14 inch WF 87-pound columns spaced on a 25-foot square. Major elements consisting of the drums, generating tubes, water cooled walls, insulated pressure casing, and burner equipment, including manifolding are hung from the top of steel which stands approximately 100 feet high. An 8-foot 8-inch diameter 60-foot stack is mounted on top of the unit to discharge gas at the same elevation as the regenerator stack. Walkways and stairs form a part of the structural steel.

Air for combustion (of both CO and the supplementary fuel) and pressurized ports for accessories is supplied via a suitable blower driven by a 250 hp electric motor. Full mechanical standby is provided by a similar blower, steam turbine driven. Both discharge into a common duct

The six auxiliary fuel oil and gas burners will include automatic gas lighters arranged to operate in two groups of three burners. Oil atomizers will be of the steam assisted Y-jet atomizing type suitable for the grades of oil to be burned.

To ensure continuous operation of the cracking unit, a CO gas by-pass system will be incorporated. The gas will pass directly to the boiler through ducting, including a water seal tank or to atmosphere through a damper installed in the original regenerator flue gas stack. Operation of the damper to permit the fuel to be piped, either to the boiler or to atmosphere, will be automatic, initiated in the event pressure in the CO duct to the unit reaches a pre-determined maximum value. A regenerator flue gas pressure of not less than 20" water gauge is required at the burners.

Instrumentation "consisting of a transmillter panel, including local indication" will be located at the base of the boiler, with master controllers and recorders installed some 150 feet distant in the cracking unit control room. Existing unit steam instrumentation will be re-grouped with the CO boiler instruments to form a centralized panel for this utility. An automatic combustion control system will be installed which will maintain the proper ratio for combustion of either of the two supplementary fuels and also compensate for the volume of CO gas admitted. Initial instrumentation does not include an oxygen and combustibles analyzer.

The contract for the CO boiler project was completed early in October 1955. Progress in the schedule indicates that steam will be generated in January 1957.

Additional facilities required by the increase in generating capacity consist of new feedwater pumps and a 500,000 lb/hr hot process lime soda water softener of the sludge blanket type.

Husky Oil and Refining Limited

Since 1953, Husky Oil & Refining Ltd. of Calgary, Alberta has expended nearly $5,500,000 in a major program of refinery expansion. Under this program which was completed in 1955, Husky expanded and improved its Lloydminster refinery, purchased two additional refineries and completely renovated them to supply additional capacity and fit into the company's operational pattern.

The throughput capacity of the Lloydminster refinery has been steadily increased during the period from 1947 to 1953 and just before the commencement of the expansion program it was rated at 5,000 b/d. Its primary products were several varieties of asphalt used extensively in road construction and the building industry and bunker "C" oil sold under contracts to the Canadian National Railways. The list of products also included lesser volumes of several fuels derived from the light and medium ends.

During 1953, Husky launched its three-phase expansion program at the Lloydminster refinery by making extensive additions in order to satisfy the steadily increasing demands for its products. Expansion was planned to fulfill a dual need: to increase refining and manufacturing capacity and to improve the quality of products even further.

Capacity was increased to 8,500 b/d by installation of new units and storage capacity. A vacuum unit, flash and fractionating tower, a specialty plant, a new blow still, additional heaters and stills and enlargement of the packaging plant all served to enhance Husky's position as a major asphalt supplier. A new catalytic reformer made higher octane ratings for Husky gasolines possible. A diesel desulfurization plant was also installed for making Husky diesel fuels, already noted for their extremely low pour point, to meet the most exacting standards of commercial users.

Late in 1954, Husky purchased two additional refineries. The refinery of Riverlake Oils Ltd. at Fort William, Ontario was purchased in October along with its associated market outlets. This refinery, the only one on the Canadian side of the Lakehead area, had a capacity at that time of 1,700 b/d. In November, another refinery, located at Moose Jaw, Sask., was acquired from a subsidiary of Trans-Empire Oils Ltd. It had a seasonal capacity of 2,000 b/d. Husky was then in a position to modernize and enlarge the two nearly acquired plants.

Construction undertaken during 1955 at Lloydminster included additional storage capacity and installation of an air-cooled gasoline condenser. At Moose Jaw, installation included a 3,000 b/d crude unit, a 650 b/d Atlantic catforming unit, 1,000 b/d Husky Dieselfiner for treating diesel fuel, 1,500 b/d vacuum unit and visbreaker, asphalt oxidizer and blending facilities, improved tank car loading and crude unloading facilities, additional storage. At Fort William, installation included a 1,000 b/d Atlantic catforming unit, 1,500 b/d vacuum unit, improved tank car loading and crude unloading facilities and additional storage.

During 1956 will be added at Lloydminster the first phase of new steam plant, additional air compression capacity, and increased pumping capacity. Additions at Moose Jaw included increased steam capacity, additional storage, new truck loading rack, new plant office, additional asphalt heating facilities and new fire fighting facilities. Plans in 1956 for Fort William include increase in crude unit capacity, installation of Husky Dieselfiner unit, enlargement of plant sewer system, new truck loading rack and truck scales, new fire fighting facilities.

Capacity of each refinery, in barrels per day, are:

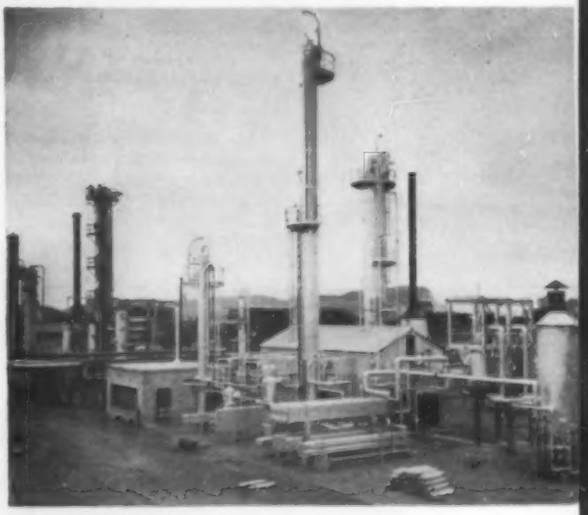
	Jan. 1, 1956	Jan. 1, 1957
Lloydminster		
Crude	8,500	8,500
Gasoline Reforming	400	400
Diesel Desulfurization	1,000	1,000
Moose Jaw		
Crude	3,000	3,000
Gasoline Reforming	650	650
Diezel Desulfurization	1,000	1,000
Vizbreaking	1,500	1,500
Fort William		
Crude	4,000	4,000
Gasoline Reforming	1,000	1,000
Diesel desulfurization	....	500

Late in 1955, all three stages of the program had been completed and Husky could report a capacity expansion from 5,000 b/d early in 1953 to 15,500 b/d at the end of 1955. The range and quality of products from the three plants have shown a commensurate increase and the flexibility brought about by the additions allows the company to apply to all three refineries the same basic pattern of operations that has proved highly successful at Lloydminster in the past. All three refineries have been designed with future growth in mind and later additions can be accomplished with a minimum of changes to existing plant.

For its supplies of crude oil to operate the refineries, Husky draws from reserves in both Saskatchewan and Alberta. Lloydminster is fed from the black oil fields in its immediate vicinity on both sides of the border. Fort William supplies are drawn primarily from southeast Saskatchewan and crude from Moose Jaw operations is from the Fosterton, Cantaur and Success fields of southwest Saskatchewan.

Although construction was in process at the two nearly acquired refineries during most of 1955, Husky increased its refinery runs by 39% over the previous year. The total for the year was 3,689,958 barrels for an average of 10,110 b/d. 1954 runs totalled 2,651,812 barrels or 7,262 b/d. The increase reflects the first complete year's operations for the expanded facilities at Lloyminster as well as production from Fort William and Moose Jaw. The dollar value of refinery sales showed an even greater increase due to considerable up-grading of products.

Construction in progress at the Moose Jaw, Sask refinery of Husky Oil & Refining Ltd.



A view of the Fort William, Ontario refinery of Husky Oil & Refining Ltd.

The recent strike by Union Oil at Red Earth has stimulated interest in the Granite Wash area of northern Alberta and Saskatchewan. This is a difficult area of operations, but Union's strike promises to make it the scene of intensive activity during 1956.

Granite Wash warms up

Seismic crewman loads geophones on truck at Socony-Mobil's Loon Lake camp, Alberta. This area is in the north, not far from the recent Red Earth discovery. (Photo courtesy of Socony-MobilOil Co. Inc.)

An Imperial Oil exploration party on the move in northwestern Canada. By means of tractor-wheeled vehicles, called weasels, the trailer camp is moved through the muskeg country.

THE Granite Wash area holds promise of joining Canada's major petroliferous provinces, if the recent trend of discoveries continues. The wave of land applications which followed Union's discovery at Red Earth is motivated by the supposition that oil has accumulated in sands eroded from granite in Alberta, which acts as a reservoir, retaining oil seeping into it from other formations butting against eroded topographical surfaces of the ancient granite. Such well-developed sands are thought to exist throughout northern Saskatchewan. As a result over 15 million acres were applied for in northern Saskatchewan and Alberta following the Red Earth find.

The area of interest extends over 500 miles in a giant arc, sweeping from Peace River down southeast to Saskatchewan toward the Canadian Shield. Generally the costs of exploration in an area such as this are high. So, however, are the potential rewards, for a strike would probably be very worthwhile. Major companies have demonstrated their interest in the play by taking up many millions of acres.

Union's strike was made on LSD 12, 17-87-8w5, 120 miles northeast of production at Sturgeon Lake and 115 miles due east of Clear Hills, the original Granite Wash discovery made in 1955. In a production test the well flowed about 800 b/d of 38° gravity oil on a two hour test. Production was from 4,744 to 4,759 feet and 4,766 to 4,780 feet. Reservoir was a porous detrital sand on top of the basement granite. Casing pressure was 600 psi; tubing pressure was 320 psi.

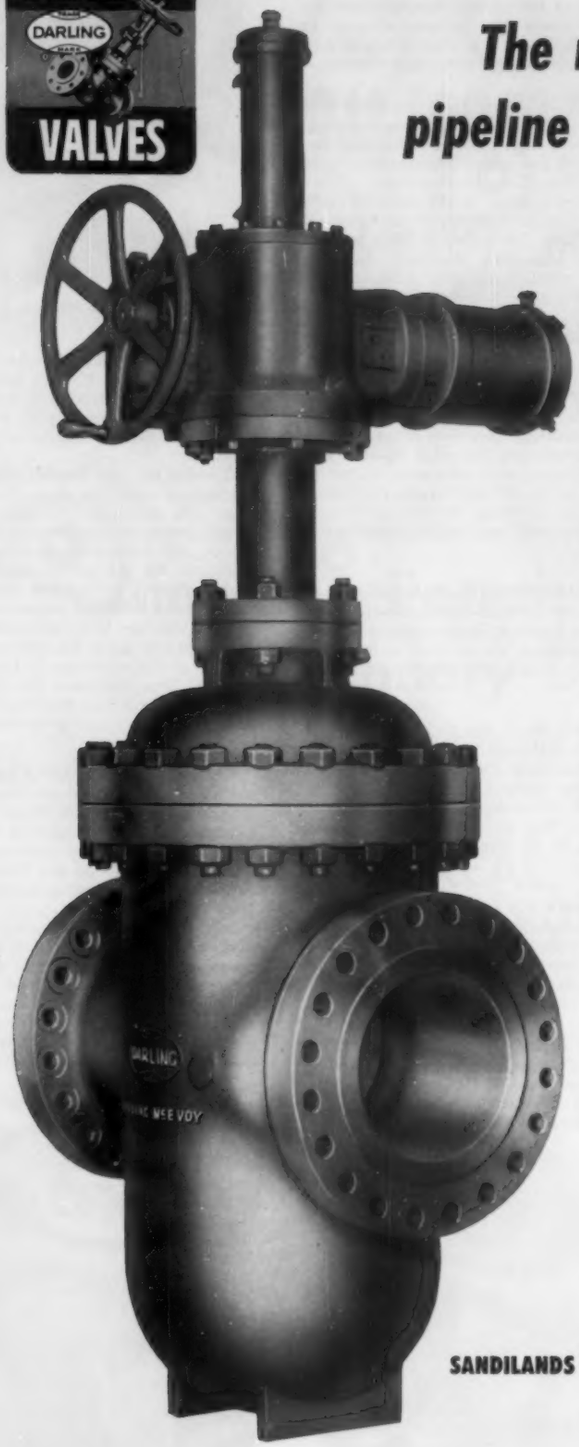
Red Earth is the first important Granite Wash strike in northeastern Alberta and Union's first well in the current play. The good pay section, a complete absence of formation water, and favorable formation pressures promised to put it near the top of promising discoveries in the last two years.

Union moved out from the discovery well immediately to drill Red Earth 14-8, about four miles north and at the same time spudded in Loon River 1-4 some 18 miles to the north. The company is running against time, for the area is muskeg and impossible to operate in during the summer.

The Granite Wash area has not been without its disappointments. Imperial Oil drilled two dry Devonian tests in 1952, some four miles from Union's well. Southern Producing has been drilling extensively on a farmout from McMahan (Pacific Petroleums) in the Granite wash in exchange for 25% interest with an additional 25% if production is found. They took the farmout after it had been offered to Howard Hughes and Eastman, Dillon and Co. and until encouraging shows were recently found had expended considerable amounts of time and money without result. The company is committed to spend $10 million on exploration and development in Alberta and British Columbia by June 30, 1958. Four wildcats were begun during December, 1955.

Other operators in the Granite Wash have included Socony Mobil, Shell, Gulf and Texas, all operating through the Northern Foothills Agreement.

DARLING VALVES



The most important pipeline valve development in years

TRADE DARLING MARK McEvoy

New self-sealing two-way conduit valve for pipeline service automatically injects sealant by means of existing line pressure

Here's a new type of conduit gate valve, available in 8-inch and larger sizes, that gives positive downstream closure without dependence on metal-to-metal contact. Each time the valve closes, the required amount of sealant is applied automatically.

How it works

Employing the time-tested McEvoy principle, two cylinders, filled with special sealant, are located within the valve. Both are operated by line pressure. Depending on the direction of flow, line pressure actuates one or the other of these cylinders to force sealant into a channel in the downstream face of the seat. Since these cylinders hold enough sealant for 50 or more closures, the valves need only periodic servicing for recharging with sealant.

Write for details

Ask for bulletin #5402 which contains complete information on the design and operation of this valve.

SANDILANDS VALVE MANUFACTURING COMPANY, LTD.

Galt, Ontario, Canada

Oil Company Staff Changes

JOHN L. BIBLE, formerly president of Tidelands Exploration Co., has opened offices as a consulting geophysicist at 216 West Covan Drive, Houston. He will specialize in gravity and magnetic supervision and interpretation, residual computations and density logs.

T. B. HOUCK, drilling superintendent for Parker Drilling Co. in West Texas and New Mexico, is in Tel Aviv, Israel, as acting manager of Pantepec Oil Co. operations there. Parker Drilling will manage Israeli drilling and production for Pantepec. Two Pantepec subsidiaries, Pan-Israel, Ltd., and Israel Mediterranean, Ltd., are operating three rigs in Israel.

DAVID J. KULL, who has returned to the United States after a foreign assignment for Shell Oil Co., has been appointed exploration manager for the Kansas division of the company.

WILLIAM L. SKAGGS, senior chemical engineer for Gulf Oil Corp. at Port Arthur, Texas, has resigned to join the Lummus Co. as process engineer at Houston.

GUY R. BRAINARD, JR., vice president of Lucerne Corp., Dallas, has been named vice president of Drilling and Exploration Co., Inc. Prior to joining Lucerne in 1951, he was assistant manager of production for Seaboard Oil Co., Dallas.

S. W. TOTTEN has been appointed vice president and general manager of exploration for the western region of The California Co., Denver.

T. A. HELLING, president of El Dorado Refining Co., El Dorado, Kan., has been elected chairman. He has been succeeded as president by George J. Peterschmidt. The board chairmanship has been vacant since the death of Charles G. Yankey, Wichita, in December 1953.

GEORGE V. MYERS has been appointed general manager of production for Standard Oil Co. (Ind.). He has been financial vice president and a director of Stanolind Oil and Gas Co. at Tulsa. Mr. Myers will coordinate Standard's production and crude oil supply activities with operations of such principal subsidiaries as Stanolind Oil and Gas Co., Service Pipe Line Co., Stanolind Oil Purchasing Co. and Tuloma Gas Products Co.

Mr. Myers joined Stanolind in 1953 as manager of the financial departments and a director of the company. Later that year he was elected to a vice presidency. Previously he had been controller of Westinghouse Air Brake Co. at Pittsburgh, Penna., and a special agent for the Federal Bureau of Investigation.

George V. Myers

JAMES E. UBBEN, of Dallas, has been appointed standardization engineer in the American Petroleum Institute's Division of Production headquarters. He will work with Edwin Joyce, assistant director in charge of standardization, on a wide range of API equipment and materials standardization projects.

WILLIAM A. WILLIAMS, former chairman and managing director of Standard-Vacuum Refining Co. of India Ltd., has been appointed assistant refining coordinator of the parent Standard-Vacuum organization at its New York headquarters.

Mr. Williams joined Stanvac in 1952 after 18 years experience in the Canadian petroleum industry, all with Imperial Oil Ltd. From 1950 to 1952 he was superintendent of Imperial's Montreal Refinery. Named to head Stanvac's refining subsidiary in India, he served during the construction and initial operations of its $35 million fuel products refinery overlooking Bombay Harbor, returning to the United States in mid-1955.

FERNANDO J. ESPINOSA has been appointed general manager of International Petroleum (Colombia) Ltd., and assistant executive representative of International's interests in Colombia. For the past four years Mr. Espinosa was general manager of Esso Colombiana, S. A., International's marketing affiliate in Colombia. A former resident of Washington, D. C., Mr. Espinosa has lived in Bogota since 1946.

WALTER C. HARBISON, engineer at the El Dorado, Ark., refinery for Pan-Am Southern Corp., has been appointed assistant chief engineer, a new post. Robert O. Robertson, an engineer at the Destrehan, La., refinery, was made assistant chief engineer at that plant.

JOHN M. PAYNE, Shell Oil Co., Houston, has been named district chairman for the American Petroleum Institute, Southern District.

Area vice-chairmen selected are Mike Dillingham, A. T. Miller, W. E. Richards, B. C. McCree, J. F. Roth, Jim Buckley, Roy A. Bobo, Bert Crowder, W. D. Taylor, and W. N. Bynum, secretary-treasurer.

DR. W. H. BAHLKE has retired as research coordinator for the Standard Oil Co. (Ind.). He joined the company as a chemist in 1921. Dr. Bahlke did his undergraduate work at Richmond College and obtained the Ph.D. degree in physical chemistry at Johns Hopkins.

HOMER J. LIVINGSTON, president of the First National Bank of Chicago, has been nominated a director of Standard Oil Co. (Indiana). Mr. Livingston would be an additional director of Standard. All 15 present directors have been renominated.

Homer J. Livingston

William R. Stott

WILLIAM R. STOTT, veteran sales executive of Standard Oil Co., (N. J.), will be proposed to the stockholders for election to the board of directors at the annual meeting May 23. Mr. Stott will succeed Chester F. Smith, who is not a candidate for re-election.

Coordinator of Jersey Standard's world-wide marketing activities since January 1954, Mr. Stott began his career as a petroleum products salesman in the Pennsylvania division of Esso Standard Oil Co. in 1929. He was appointed deputy marketing coordinator for the parent company in August 1953 and marketing coordinator five months later.

Mr. Smith was first employed by Jersey Standard in 1908 and has been continuously associated with the company since his graduation from the University of Pennsylvania in 1913. He became president of Esso Standard Oil Co. in 1940 and was elected to the Jersey Standard board of directors in 1944, becoming a vice president two years later.

GEORGE F. HORNADAY has been appointed assistant manager of process sales for Houdry Process Corp. He has been with Houdry since 1940 when he became assistant manager of development. Shortly after Pearl Harbor, he was assigned to the special group that developed the Houdry dehydrogenation process for single-step production of butadiene from normal butane.

Subsequently, Mr. Hornaday occupied various administrative and supervisory posts connected with research and development of catalytic cracking and reforming. In 1952 he joined the commercial development department and has represented Houdry in discussions leading to recent licensing of large dehydrogenation units in Europe and the United States, as well as other Houdry processes.

George F. Hornaday

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(Refinery Division)

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MAY 14 – MAY 17 – 1956

WHITE ROSE

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London Letter

I.C.I. Patrochemical Expansion

Imperial Chemical Industries, Ltd. will construct at Wilton further units for olefine production and butadiene extraction in 1956, a second paraxylene and another "Terylene" unit, and a "Butakon" plant. The last will use raw material from the butadiene plant to produce a range of copolymers used in emulsion paints and shoe-soling products. Some $140 million has been spent on Wilton to date.

New Tanker Jetty at Swansea

British Petroleum Co. has opened a new $1,680,000 tanker jetty at Queen's Dock, Swansea. The jetty had two berths, twenty 1,500 and 2,500-ton storage tanks, and a full range of refined oils can be handled. A fleet of nine specially designed tankers is being built by Shell-Mex & B.P. for service in British estuaries and rivers. The company's managing director—C. M. Vignoles stated that fuel oil demand by 1960 will be three times 1955 consumption.

Tubeseals on British Tanks

A new method of eliminating vapor loss in petroleum storage has been completed for Mobil Oil's Coryton refinery by Wm. Neill & Son (St. Helens) Ltd. Two million gallon tanks, 80 feet in diameter by 36 feet high, have twin skin steel floating roofs which move up and down on the surface of the stored liquid. Between floating roofs and tank walls are fitted huge 80 feet diameter tires made of nylon fabric base coated on each side with butadiene acrylonitrile synthetic rubber. The tires are partly inflated with liquid and secured to the floating roof, thus preventing vapor from forming and also acting as a complete seal.

New Steam and Gas Turbines

The British Admiralty has announced use of steam and gas turbines geared to the same propeller shaft. The steam turbine will be used for normal cruising speeds, while the gas turbine will provide a boost for sustained high-speed. Metropolitan-Vickers Electrical Co. is designing and manufacturing the steam and gas turbines, gearing and control gear and is to carry out shore tests.

57-Ton Trucks for Arabian Desert

Eight specialized 6-wheeled drive Constructor tractors have recently been shipped for use by Iraq Petroleum Co. in a 300-mile desert shuttle service to their Jebel Fahud test well in southern Arabia. The trucks have special dustproofing equipment, 40-gallon drinking water tanks, dual fuel tanks for 140 gallons of diesel oil, sand tires, and special hollow bumper bars for carrying additional engine water. These Scammell tractors have a 25-ton payload and a gross train weight of 57 tons. The first loaded tractor did the 300-mile journey at an average running speed of 13½ mph, taking 2½ days.

South African Lubricating Plant

Shell Co. of South Africa's new large scale lubricating oil blending and packaging plant at Durban will be engineered and built by the British contractors W. J. Fraser & Co., of Romford, Essex, in association with its associates Frasers and Chalmers (South Africa) Pty. Ltd.

U. S. Instruments in Britain

The West Instrument Corp. of Chicago, Illinois, has formed a British subsidiary, West Instrument Ltd., with a factory at Hersham, Surrey, to manufacture temperature control equipment for various types of thermal processing.

Company Finance

Cleveland Petroleum Co. (Esso Petroleum U.K. subsidiary) has reported total sales in 1955 exceeded 1954. Trading profit, however, decreased by £43,398 to £288,009 ($806,400) due mainly to increased distribution cost. A substantial outlay of working capital was necessary last year. Directors anticipate a further substantial increase in 1956.

Antwerp Oil Wharves Ltd. shows a net profit, after taxation, for the year to September 30, 1955, of £23,089 ($54,649) against £20,444 the year before. An ordinary dividend of 8¾%, less tax, was declared, compared with 7½% in 1954.

Sales of T.P.D. Shares

The secretary of British Controlled Oilfields announced March 19th that the Canadian liquidator of the company would shortly issue a statement on the possible sale of its 50 percent holding of Trinidad Petroleum Development Ltd. Reports in London state that this holding had been sold to U.S. oil interests for over $11 million but no official confirmation or denial was obtainable.

Alexander Duckham & Co., lubricating oil manufacturers and distributors, report a trading profit for 1955 of £167,251 ($468,303) against £165,871 in 1954. Net profit was £108,893 ($304,900) against £114,071 ($319,399) in 1954. The total dividend is maintained at 20%, less tax.

British Radio Link for Daura Refinery

Iraq Government's Daura refinery is to be supplied with short wave telephonic radio equipment by Redifon Ltd., London. The order involves two Redifon G.40 transmitters and 50M receivers and will permit 2-way conversation between the Kirkuk oilfield and the refinery.

Floating 9,000-Ton Tanks

At Shell's Stanlow refinery, Cheshire, ten 9,000-ton tanks, weighing 300 tons each, have been moved 500 yards as they were obstructing the current expansion programs. Five of these were floated to the new site along a specially built canal 50 yards wide and 500 yards long. To fill the canal and tank compounds to about 3 feet 6 inches some 24,000,000 gallons of water had to be pumped by eight diesel-driven pumps and frogmen proved valuable in fixing the exact tank sites from underwater.

Pulsometer Engineering and Dresser Industries

Pulsometer Engineering Co. announces an increase of capital and productive facilities, and closer relations with its U. S. associates, Dresser Industries, Inc. The latter has acquired a substantial shareholding in Pulsometer Engineering. A director of the wholly owned Dresser subsidiary, Pacific Pumps, Inc., will shortly join the Pulsometer board. A new long term licensing agreement between Pulsometer and Pacific Pumps will bring the complete range, instead of a limited line, of Pacific pumps into manufacture by Pulsometer.

B.E.A. Contract For B.P.

British European Airways has awarded British Petroleum Co. a contract for the supply of aviation fuel requirements for three years from April 1st. Contract value is between $22,400,000 and $23,800,000. It calls for supply of about 400,000 tons (2,800,000 barrels) of fuels, of which 330,000 tons (about 2,310,000 barrels) will be turbine fuel and the balance gasoline.

The Peregrine Diesel

Parsons Engineering Co., Southampton, has announced a new type of air-cooled 3-cylinder light marine diesel engine to be known as the "Peregrine." This has a capacity of 2,964 cc, develops 33 bhp at 1,800 rpm, and is fitted with Parsons reverse gear. It is stated to be the accepted marine version of the Armstrong Siddeley air-cooled light industrial engine.

Tanker News

Hunter & Sons, Ltd., a member of the Hunting Group, has placed orders for three new tankers, two of 24,500 and 32,500 dwt respectively, the third, of 18,000 dwt.

Successful trials have been run of the bulk bitumen carrier the "Esso Preston," built for Esso Petroleum Co. This single screw steam tanker of about 2,300 dwt has five center cargo compartments for hot bitumen. Steam for propulsion and heating is provided by two single ended, oil fired Scotch marine boilers designed for a working pressure of 225 lb psi and a steam temperature of 500°F at the superheater outlet.

The oil tanker "Auris," one of the Shell Fleet of tankers, and the first merchant ship ever to be driven by a gas turbine has now operated at full power for 17,510 hours. Various grades of fuel have been employed and experiments made with corrosion and deposition problems.

When the high pressure part of the turbine was opened up after a year's service and use of 500 tons of boiler fuel of varying viscosity, there were no traces of corrosion found.

Accumulation of salt deposits on the blades has been overcome by removal of salt from sea spray drawn into the compressor with the air by water injection. Soot on the heat exchanger tubes is removed by steam jets.

The British Thomson-Houston 5,500 hp turbine may shortly be installed in the "Auris." It will have a fuel economy comparable to a steam turbine and will operate on the same low-grade fuel, while the maintenance costs will be lower.

New "T" Head Jetty at Coryton

The second ocean-going jetty being built at Mobil Oil Co.'s Coryton refinery is due for completion this summer. The jetty is of "T" head construction and will be able to handle most of the supertankers in sight. The platform for the handling equipment is flanked on either side by two breasting dolphins and the hose handling equipment to be installed is to be found only at Socony Mobil's Paulsboro' refinery.

Personnels

H. C. Tett and R. J. Pinder have been appointed managing directors of Esso Petroleum Co., Ltd. C. Chilvers, manager of the coordination and economics department, has been appointed to the board. William E. Jenkins, C.B.E., has retired from his position as a managing director; he has been a member of the board since 1945.

J. C. C. Taylor has retired as aviation sales manager of Shell-Mex and B.P. Ltd.

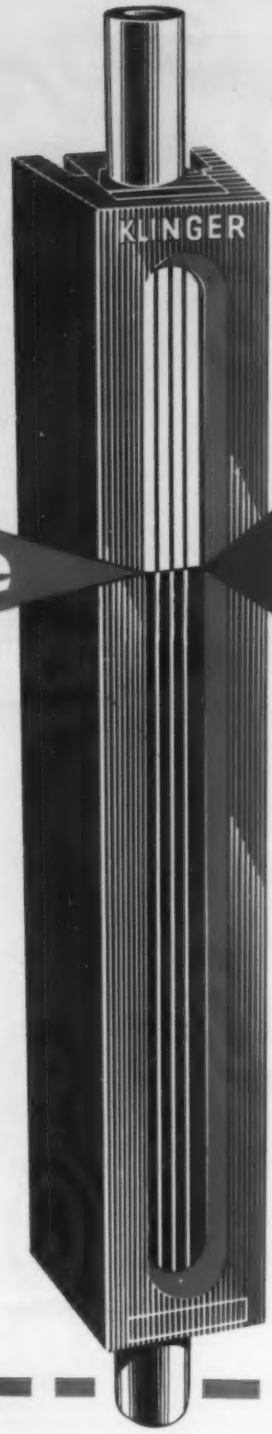
V. C. Varcoe has been appointed aviation sales manager, head office, Shell-Mex and B. P., in succession to J. C. C. Taylor.

Lord Forres, W. H. Williamson, L. W. Berry and W. Howard-Williams have resigned from the board of Anglo-Ecuadorian Oilfields, Ltd. This follows the acquisition of the company by Lobitos Oilfields, Ltd., and the South American Gold and Platinum Co. and the decision to move central management and control for U.K. taxation purposes to Ecuador. Lewis B. Harder, Edward A. Merkle, C. W. Morton and R. C. Stanley, Jr., all of U.S. nationality, have been appointed directors of the company, as have George W. V. Rumble and Harry Shephard, both of British nationality.

The Hon. J. K. Weir has relinquished his joint managing directorship of G. & J. Weir, Ltd. to devote his whole time as chairman of the Weir group of companies and J. Russell Lang has been appointed sole managing director. Sir Charles Connell, M.A., chairman of Charles Connell & Co., Ltd., shipbuilders of Glasgow, has been appointed an additional director.

F. N. Hudson, general sales manager (industrial) of Mobil Oil Co., Ltd., has retired after 42 years' service with the company. He was made a member of the Order of the British Empire (M.B.E.) this year, in recognition of his distinguished and varied contribution to the affairs of the oil industry. He was succeeded by G. M. McGavin.

Reginald S. Medlock, head of George Kent, Ltd.'s research and development department since 1951, has been appointed a director.



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International News and Notes

New Pipe Line In Syria

A 50-mile crude oil pipe line from Homs, Syria, to the Mediterranean, is under active study by the Iraq Petroleum Co. IPC plans the line to Tripoli, Lebanon, across Syria, in the event it can come to an agreement with Lebanon. If not, the line may run to Banias, Syria.

The line would be 24 inches in diameter; it would increase the throughput of the present 30 and 32-inch line by about 8,000,000 long tons (160,000 b/d) of crude a year. A part of the plan might be to deviate the pipe lines once terminating in Haifa.

The Homs Tripoli line cleared one hurdle November 29, when IPC and Syria came to a revised agreement on revenues for Syria, (WORLD PETROLEUM, March 1956) A supplementary agreement allocates up to 20% of Syria's share of the products of the Tripoli refinery, which is IPC owned, to the Syrian government or its nominees.

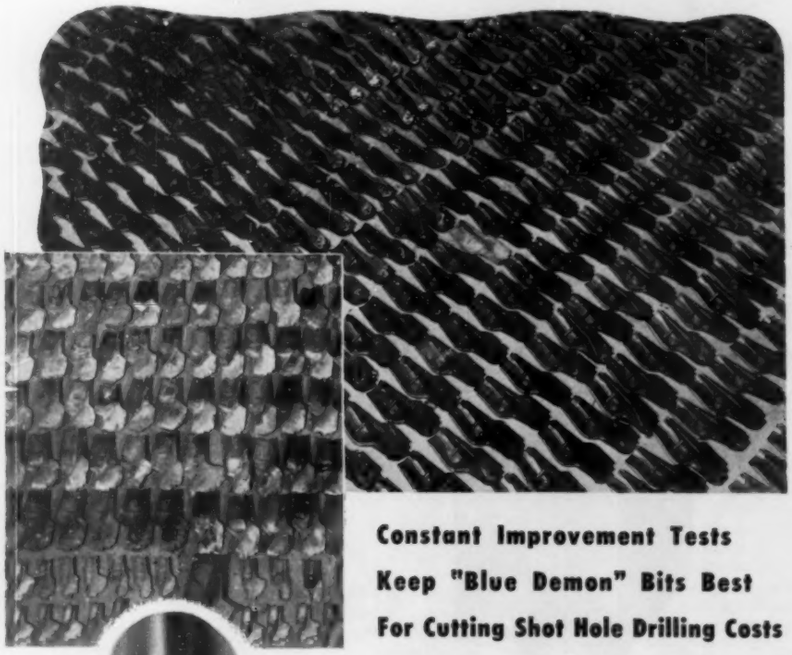
Crude oil shipped to Banias, Syria, through the IPC line during 1955 came to 17,045,000 long tons (about 341,000 b/d), compared with 17,126,000 (about 342,400 b/d) in 1954. Crude pumped through the IPC line to Tripoli came to 7,664,000 tons (about 153,800 b/d) in 1955, compared with 7,651,000 (about 153,200 b/d) in 1954.

Crude shipped through the Trans-Arabian Pipe Line, which has its outlet at Sidon, Lebanon, came to 319,178 during 1955.

Iranian Oil Report

The full report of the Majlis Oil Committee on oil operations in Iran has been translated and a few copies are circulating in Washington. The report, made February 21, is the best account yet of past, present and future operations in Iran since the signing of the agreement October 29, 1954 to the end of 1955.

● When measuring the costs of a hole in the ground



Constant Improvement Tests Keep "Blue Demon" Bits Best For Cutting Shot Hole Drilling Costs

U.S. Patents 2,635,694 & 2,666,622 — Others Pending

PICTURED above are a few of the many "Blue Demon" Blades required annually for continual shop and field improvement tests by the Hawthorne plant—providing proven-product bit performance which keeps "Blue Demons" leading the way in lowering your shot hole drilling costs.

This shop and field experimental research means that "Blue Demon" Bits have been thoroughly pre-tested *before* demonstration on your drill—eliminating obsolescence before these bits reach the field.

Ask your Hawthorne field service engineer for a demonstration on your rig, without obligation—or call your nearest Hawthorne representative today for fast, dependable delivery of the size and style of Hawthorne bits best suited for your particular drilling area.

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Oil Shows In Algeria

The only company with private participation exploring in French North Africa, CREPS (Compagnie de Recherches et d'Exploitation de Petroleau Sahara), has announced encouraging oil shows in a wild cat in extreme southeast Algeria near Fort Flatters. This area is located near the border of Libya and could have important effects on exploration in that country. The company is owned 35% by Shell, 55% by RAP (the French Government's Regie Autonome des Petroles), 5% by BRP and 5% by S. N. Repal. The latter three companies are owned by the French and/or Algerian Government.

New Somalia Well

A new well is to be started in June in Somalia (Italian Somaliland), it is reported by T. L. Donovan, of Sinclair Somal Corp., Mogadiscio, Somalia.

West Bengal Exploration Delayed

The Prime Minister of India, in debate before the House, disclosed that terms of Standard-Vacuum Oil Co.'s offer to explore in West Bengal could not be disclosed at this time, pending settlement of negotiations with other interested companies. He stated, however, that no lease has been granted to Standard-Vacuum as yet.

Aerial Survey In Ceylon

Over the next two years, a complete aerial survey is to be made of Ceylon's natural resources, following an agreement reached between Ceylon and Canada in the framework of the Colombo Plan. Aerial photographs will be taken of the island by a Canadian firm and studied by Cingalese technicians.

Crude Imports Into Japan

Japan imported a total of 146,500 b/d of crude oil during 1955, according to reports from the Japanese customs bureau. Of the total, about 50% was from Saudi Arabia.

1955 Production In Hungary

Hungary produced 1.6 million metric tons of crude oil in 1955 (about 32,000 b/d) or 31.6% more than in 1954, according to the government.

New Sisak Refinery In Yugoslavia

A new refinery with 320,000 metric tons (about 6,400 b/d) capacity was scheduled to go on stream in Sisak (Slovenia province) at the beginning of March. The plant was built in West Germany, reportedly under American lincense. A thermo-electric power station with two turbo-generators of 5,000 kw each will be used.

The old refinery in Sisak was almost entirely destroyed during World War II. The old and the new refineries together will produce about 550,000 m/tons (about 11,000 b/d).

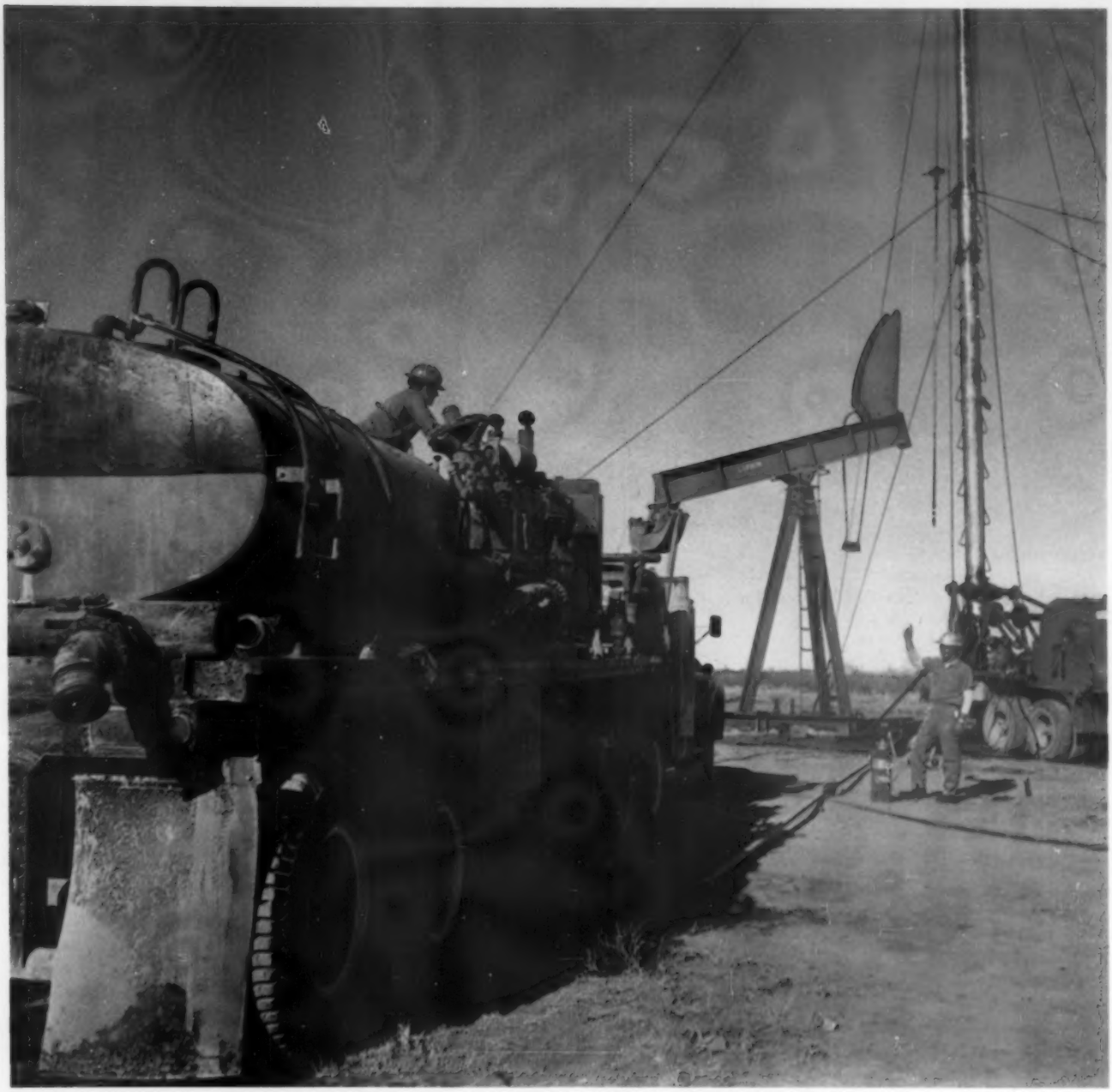
Oil In Austria Brings New Elections

Failure of negotiations on the future status of Austria's oil industry has led to dissolution of Parliament and the holding of new elections on May 13, 1956. The dispute is between the Austrian People's party, which advocates pooling of the oil industry in a corporation in which the Federal Government and the Provincial Government of Lower Austria have shares, the remaining stock being low-priced "popular shares," and the Socialist Party of Austria, advocating total nationalization and administration by the Socialist-dominated Ministry of Transportation and Nationalized Industries.

Oesterreichische Mineraloel Verwaltung (Austrian Mineral Oil Administration), presently employing about 10,000 people, has announced plans for drilling of new gas wells, further electrification of the Matzen oil field, building of roads and laying of oil and gas pipe lines in 1956.

Attention will be directed toward the utilization of flared gas, now about 17,655 mcf, through foundation of a petrochemical industry.

(*Continued on page* 180)



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Today it's a different story. Skilled engineers use a variety of Dowell-developed materials to tailor acidizing to your well, for example: high-temperature inhibitors; temporary plugs; retarded acid; non-emulsifying, low surface tension and silicate control additives. What's more, these engineers use highly specialized pumping equipment and are backed by Dowell's 24 years of oilfield experience. These are the *extras* you get when you call Dowell for acidizing services.

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Latin American Oil News

Production And Consumption In Peru

Peru had 3,347 producing oil wells at the start of 1956, a gain of 125 from a year earlier, according to Washington reports.

There were 26 active drilling rigs in the country at the end of 1955. A breakdown by companies is as follows: International Petroleum Co., Talara-Negrites, 8; Cia Petrolera Lobitos, Lobitos—El Alto, 13; Ave. Joint Operation, 3; Empresa Petrolera Fiscal, Zorritos 2.

A total of 168 wells were drilled during 1955, of which 114 were oil wells, 15 gas wells and 39 dry holes. By companies, International completed 26 oil wells, 15 gas wells and 11 dry holes, as well as five exploratory oil wells and 2 exporatory dry holes. Cia. Petrolera completed 83 oil wells, no gas wells and 26 dry holes.

Here are the figures by companies of producing oil wells, as of December 31, 1955:

International	1,975
Cia. Petrolera	1,345
Empresa	127
Ganso Azul	Not Available
Total	3,347

During the year 1955, a total of 12,749,930 barrels of petroleum products went into domestic marketing channels. Here are the products by produce figures:

	Barrels
Motor gasoline	4,419,902
Kerosine	1,760,863
Diesel oil	2,020,943
Heavy fuel oil	3,979,472
Av. gasol	275,603
Lubricants	69,930
Liq. pet. gas.	45,055
Other	443
Total	12,749,930 (34,931 b/d)

Imports of heavy fuel oil came to 1,244,400 barrels. Crude oil stocks came to 900,734 barrels at the close of the year; crude oil and product stocks to 3,099,054 barrels.

Cuban Production, Imports Up

Cuban crude oil production came to 1,012 b/d during 1955, compared with 139 b/d in 1954. Naphtha production was 17 b/d and 18 b/d respectively.

Runs to stills came to 10,312 b/d in 1955 and 8,971 b/d in 1954. In 1955, Esso had 9,439 b/d and Refineria Cabaiguan 347 b/d.

Cuban Petroleum Imports (b/d)

	1955	*1954*
Avgas	202,925	221,459
Motor fuel	3,681,174	3,502,889
Kerosine	16	33
Distillate	1,285,575	1,060,217
Lube oils	200,594	184,953
Grease	20,714	24,654
Crude	3,602,997	3,349,349
Total	8,994,195 (24,642 b/d)	8,343,554 (22,859 b/d)

The total price of standard grade gasoline is 32 cents in Havana, of which the duty is 2.69 cents and the tax 11.19 cents per gallon.

Development In Trinidad

A total of 213 new wells were drilled in Trinidad during 1955.

The stocks as of Dec. 31, 1955, in Trinidad are as follows: aviation gasoline (100 octane), 31,269 bbls.; aviation gasoline (other), 149,935 bbls.; motor gasoline, 1,040,191 bbls.; white gasoline, 1,707 bbls.; kerosine, 73,756 bbls.; vaporizing oil, 260,691 bbls.; gas and diesel oil, 953,895 bbls.; fuel oils, 1,447,324 bbls.; lube oils and grease, 18,040 bbls.; bitumen, 61,870 bbls.; other finished products, 46,907 bbls.; liquified petroleum gas, 435 bbls.; feed and blending stocks, 391,114 bbls.; crude oil 1,374,489 bbls.

Chilean Production

Chile was producing crude oil at the rate of 8,800 b/d at the start of this year. A year earlier, the production was running at 6,000 b/d.

During 1956, crude oil production came to 7,052 b/d; natural gas output came to 477,141,200 cubic meters (16.8 mmmcf), some 326,021,000 of cubic meters of which was used for reinjection.

Here are the figures: footage drilled added up to 390,066 feet in 1955, some 35% more than in 1954. A total of 58 wells were drilled in 1955, against 40 in 1954. Of the 58, 25 found oil, 8 found gas and 25 were dry holes.

Of exploratory wells, totaling 15, none found oil; 3 found gas and 12 were dry. Of extension wells, four found oil, none found gas and three were dry. Of production wells, 21 found oil, five found gas and 10 were dry.

Footage drilled increased quarter by quarter through the year as follows (in meters):

First quarter	27,461.55
Second quarter	29,335.30
Third quarter	28,889.80
Fourth quarter	33,235.87
Total	118,922.52 (390,066 feet)

A bill to admit private capital to develop Chilean crude oil may be submitted to the Congress this year. So says Robert W. Wagner, commercial attaché of the U. S. Embassy in Santiago. At present, the government outfit, Empresa Nacional del Petroleo, handles all oil operations.

Mexican Cancellation Appealed

Mexico's First District Court is studying an appeal of the National Oil Co. for an injunction against the government's recent cancellation of oil rights held by the firm since 1933.

The tribunal agreed to take the case under consideration after the company pointed out that its concession to exploit hydrocarbons on a 12,683-square-meter tract (3.13 acres) in the Panuco, Usuluama and Tantoyuca sections of Veracruz was not affected by the 1938 expropriation decree of former President Lazaro Cardenas.

In spite of this apparent immunity, National's attorneys testified, its rights were cancelled last January 30 on the pretext it owned the government the equivalent of $821.44—a sum, they assured the court, the company can pay at any time.

Pays $288 Million To Venezuela

Creole's payments to the Venezuelan Government for royalty, income and other taxes on 1955 operations will amount to $288,403,000, an increase of 21% over 1954. In accordance with the principle of equal participation in the profits of the oil industry as set forth in the Venezuelan income tax law, this is equivalent to the company's net income from its Venezuelan operations.

Creole's net production, plus purchased royalty oil, during the year 1955, averaged 980,147 b/d, an increase of 19% over 1954, according to the 1955 annual report.

Net income for the year amounted to $292,943,913, or $3.78 per share, whereas 1954 income was $239,650,741, or $3.09 per share. Stockholders approved a 3-for-1 split on May 20, 1955. Dividends paid amounted to $275,465,551, or $3.55 per share, in 1955. The comparable figure for the previous year was $2.50 per share.

Brazil Refining Runs, Consumption Up

1955 refining runs totalled 24,161,766 barrels, 1.5% over 1954. The 1955 total was composed of 46.29% gasoline, 39.97% fuel oil, 8.88% diesel oil, 2.08% gas, 0.37% kerosine and 0.22% solvents. 1955 consumption of refined products averaged 181,793 b/d, 12.5% over 1954. In 1955, 88.62% of consumption was imported.

R. Carson Allan

Venezuelean Appointment

R. Carson Allan has been appointed manager for The National Supply Co. in Venezuela. He succeeds J. S. Blair, Jr., who was recently named sales manager, drilling equipment, with headquarters in Pittsburgh.

Argentine Oil Investments By Y.P.F.

Y.P.F. plans the following investments: gas pipe line from Campo Duran-B.A., $76 million; oil pipe line Campo Duran-San Lorenzo, $24 million; oil pipe line Mendoza-San Lorenzo, $19 million; manufacturing plant in Campo Curan, $13 million; additions to Lujan de Cuyo refinery, $15 million; refinery in the vicinity of B.S., $18 million; lubricating oil project, $4 million; new storage and distribution plants, $5 million; drilling contracts and purchase of equipment for oilfield exploitation, $76 million. Total amount is $250 million.

The above total does not include the Argentine pesos for materials and equipment that may be acquired or built in Argentina.

This investment is to be made during the next three years to enable YPF to increase its present production from 4 million metric tons (26.3 million barrels) of crude oil per year to 10 million metric tons (69 million barrels).

No consideration whatsoever, the government has announced, will be given to offers that may require oil land concessions, payments in oil or any system outside a payment to amortize the loan, made either in money, machinery, equipment, execution of jobs or engineering services.

The contracts will be entered into by YPF, and the Central Bank of the Argentine Republic will guarantee the payments and amortizations of the loans and interests in which YPF will incur.

Oil Shows In Costa Rica

Compania Petrolera de Costa Rica, a subsidiary of the Union Oil Co. of California, has reported oil wildcat well, Cocoles #1, in southern Costa Rica, the Panama border. Well depth at the time of the announcement was 5,500 feet. Previous shows had been reported at about 3,700 feet.

Company officials described the traces as "very slow due to coring." Cocoles #1 is located approximately ½ mile from the Caribbean coast of Costa Rica. Four previous wells were abandoned by Union as dry.

Uruguay—Imports And Refining

Crude runs to still in Uruguay came to 20,424 b/d during the fourth quarter of 1955, according to ANCAP, the government fuel monopoly. Fourth quarter crude imports were 21,456 b/d from Venezuela and 1,326 b/d from Arabia.

New Posts At Esso Colombiana

Adrian W. Silenzi has been named general manager of Esso Colombiana, S.A., R. A. Parsley, Jr., has been transferred to Bogota to become assistant general manager, and F. J. Dostaler has been appointed manager of the supply and transportation department. D. C. Brooks was appointed operations manager for the company.

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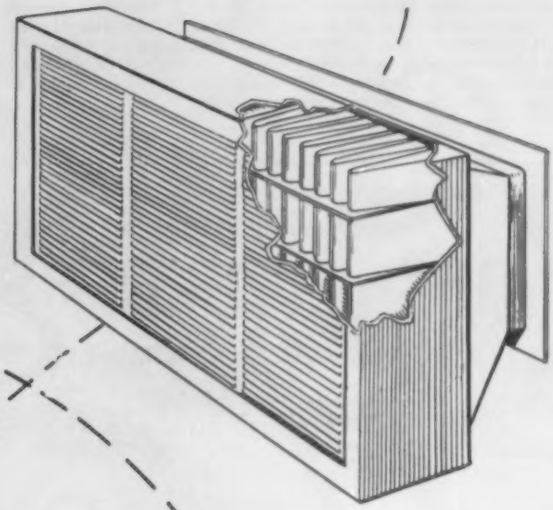

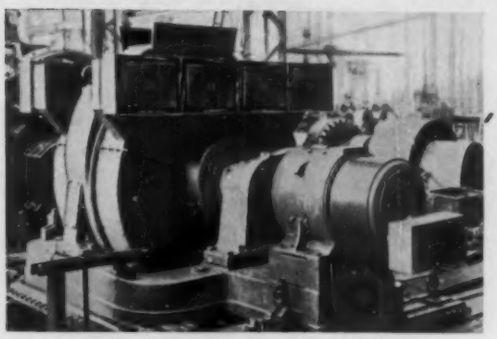

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V116A

Pembina Progress

(*Continued from page 86*)

ated for a period of eight to ten minutes at pressures of from 800 to 1000 psi to provide the large volume of fluid necessary to pump any small iron up the hole and well away from the core head. The core head is then immediately placed on bottom and rotation commenced. When the diamond bit has dug to a point where the sub has followed it down nearly to the derrick floor, the slips are set in the rotary table with the bit on bottom and an additional joint of drill pipe added to the string by means of a mousehole connection. These connections can be made fast enough to prevent any possibility of the return of iron particles to bottom which would endanger the core head.

Field experience on the completion of approximately 70 wells in the Pembina area with this tool has proven so satisfactory that where it is used the necessity for junk basket and magnet runs, before running the core barrel, has been eliminated. Since the power sub has been in operation in Pembina, not one diamond core head has been marked or injured in any way by small iron in any hole where the power sub has been used.

Since the power drilling sub's original development as a tool to improve diamond coring practices in Pembina, several additional uses and applications have been found for it. The power sub provides a means of staying on bottom while directional-drilling through a whipstock milled window so that feeling for the window entrance after a connection has been made is unnecessary. Where the surface formation is extremely hard, the power sub has proven to be an extremely valuable tool to be used in spudding and drilling ratholes and mouseholes. To obtain sufficient weight on the bit to drill these hard surface formations, the sub has been used as a spudding tool, since it is possible to start drilling immediately with the full weight of two large drill collars on the bit-eliminating use of the kelly.

The following illustrates how the use of the power sub has reduced coring costs in Pembina:

Item	*Power Sub*	*Conventional Method*
Supervision/day	$ 40.00	$ 40.00
Rental of magnet/day	00.00	100.00
Cost of magnet runs (approx. 2)	.00	300.00
Cost of bit wear/foot	5.00	8.00
Rental of power sub/job	350.00	.00
average cost/foot	$ 28.00	$ 38.00

The power drilling sub and the S3P have been developed and perfected in Pembina. These two improvements have helped the Pembina operators to do a better job, cheaper and faster.

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Uranium Research

The Ohio Oil Co., in association with Arthur E. Pew, Jr. of Philadelphia, has concluded arrangements to sell uranium concentrates to the U. S. Atomic Energy Commission. The associates propose to produce the uranium concentrate from lignite ores from the western part of North and South Dakota.

The associates have conducted considerable research, through the Catalytic Construction Co., toward developing an economic process for recovery of uranium from the lignites. Further development of the process will be conducted in a pilot plant at the Colorado School of Mines. The associates have retained Catalytic Construction Co. to proceed with pilot plant operations.

New 20-Inch Crude Line

Plans for the construction of a 20-inch crude oil pipeline from East Chicago, Indiana, to Cygnet, Ohio, have been announced by Ashland Oil and Refining Co., The Pure Oil Co. and Sinclair Pipe Line Co. The line, to be known as the Tecumseh Pipe Line Co., will connect to principal crude pipe line carriers in the Chicago area for the continued movement of crude oil to Ohio, Michigan, New York and other points in the East.

New AAPG (Rocky Mountain) Officers

The new president of the Rocky Mountain section of the American Association of Petroleum Geologists is Frank Neighbor of Salt Lake City. He will succeed F. A. Thurman, a Denver consultant. Mr. Neighbor is with Sun Oil Co. Dave Moore of Casper, Wyoming, will be the new vice president and Walter Quigley of Salt Lake City, new secretary-treasurer.

Named Vice President

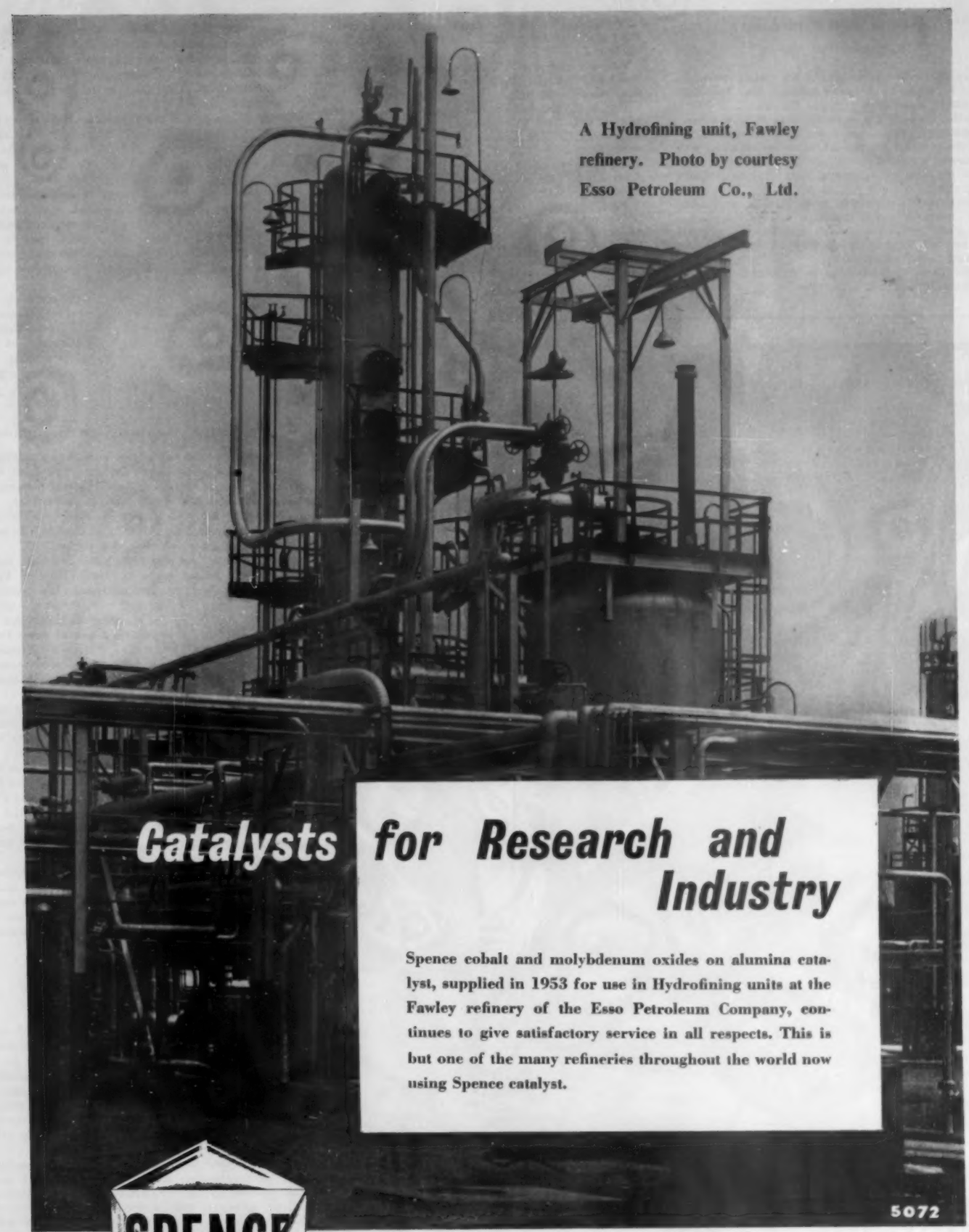
Guy R. Brainard, Jr., formerly vice president of Lucerne Corp. of Dallas, and associated with the oil industry for many years, has been named vice president of Drilling and Exploration Co., Inc. Prior to joining Lucerne in 1951, Mr. Brainard had been associated with the Seaboard Oil Co. as assistant manager of production in their Dallas office.

Co-Op To Build Platformer

Indiana Farm Bureau Cooperative Assoc., Inc. will build a 3,000 b/d Platformer and a 2,100 b/d Unifiner, both licensed by Universal Oil Products Co. Southwestern Engineering Co. is contractor.

To Build Ethylene Oxide Plant

The Scientific Design Co., Inc. will design and engineer an ethylene oxide and ethylene glycol plant for General Aniline and Film Corp. The new $8 million plant will be located at the Dyestuff and Chemical Division plant in Linden, N. J., with initial operation scheduled in 1957. The direct oxidation, one-step process will be used.



A Hydrofining unit, Fawley refinery. Photo by courtesy Esso Petroleum Co., Ltd.

Catalysts for Research and Industry

Spence cobalt and molybdenum oxides on alumina catalyst, supplied in 1953 for use in Hydrofining units at the Fawley refinery of the Esso Petroleum Company, continues to give satisfactory service in all respects. This is but one of the many refineries throughout the world now using Spence catalyst.

5072

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Washington Pipe Line

(Continued from page 5)

Motions to dismiss are due at the end of the direct case. People's, Michigan-Wisconsin, and Northern are among those sure to file to dismiss.

If the motions are granted, that ends the case, except for appeals, presumably up to the courts.

If the motions are denied, cross-examination will get under way, but not before late summer or even early autumn, as attorneys need time to prepare their cases.

Cross-examination will need months, and after that Tennessee and Midwestern will have a chance to put on their direct cases in rebuttal.

Time for filing of briefs may be expected, and then an examiner's report.

Exceptions of briefs may be expected, and then an examiner's report.

Exceptions to the examiner's report are to come, then oral argument before the full FPC. Finally a decision.

Appeals from the FPC decision are anticipated to the courts. All in all, it may be years before the case comes to an end.

One of the problems of the Tennessee-Midwestern project gets back to which came first, the chicken or the egg. That is, Canada is withholding the three certificates needed for the export of natural gas—from Alberta, and Canada's Board of Transport and from the Minister of Trade. First, says Canada, the FPC should act.

At the same time, the FPC, under the strict letter of its authority, must find an applicant has a supply of gas before it gives a certificate. How this is handled is one problem.

Further, the Tennessee-Midwestern project depends for a market on The Inland Steel Co. plant in Gary, Indiana. But Indiana authorities have yet to approve the sale of gas (45 million cubic feet daily) to the plant. A question is, can the FPC give a certificate without this approval? Sales to a U. S. Steel Corp. plant in Chicago, do not call for Illinois state approval. The quantity is 70 million cubic feet daily.

Thirdly, a part of the Tennessee-Midwestern plan is to buy gas at Niagara Falls from Trans-Canada ultimately for import into the United States. As yet, the record is cloudy on how much gas, the price, and for how long a period it will be sold.

A spokesman for Trans-Canada, summing up the case towards the end of April, had this to say: "I had hoped for faster action, but if you look back at the time taken in other major cases, such as the Pacific Northwest matter, I'm not too disappointed. The case had 61 witnesses and we are now up to exhibit 301.

"As far as the case is concerned, the contracts, the plans of engineers, the status and development of the whole case, the present argument, Trans-Canada is closer to getting its line built than it ever has been. The present case began last November, but Trans-Canada has been trying to build up a pipe line since August, 1951."

FPC Ruling Against Gas to Canada

On the opposite side of the fence from the Trans-Canada case, Panhandle Eastern Pipe Line Co., Kansas City, Mo., faces an uphill fight if it wants to export more natural gas to Canada at this time.

The company, which has been exporting 5,500,000 mcf annually to Union Gas Co. of Canada, has been seeking permission to triple this volume.

An examiner for the FPC, after hearings, ruled against the export early in March. He said Panhandle's supply is too limited against the demands of its customers. He also suggested Panhandle could feed the supply into the underground storage in Howell Field in Michigan. He allocated other Panhandle gas among Panhandle's wholesale customers.

Panhandle is appealing the examiner's decision to the full commission. A ruling should come during the spring.

The examiner's opinion was notable since it took account of the effect of any decision upon United States coal producers. In the past, the FPC has given little weight to view of competing fuels.

The examiner said: "The examiner finds, in the language of the coal interests in their brief, that the proposed exportation 'will do substantial injury to a large segment of American labor and capital in that it would result in the displacement of large quantities of bituminous coal and anthracite produced in the United States.'

"As in the case of an application for a certificate of convenience and necessity for natural gas facilities and service, so here the economic impact upon the coal and railroad industries and employees in such industries is a factor to be taken into account in the commission's determination."

Esso Executive to Head Missile Program

Eger V. Murphree, president of Esso Research and Engineering Company, has been named Special Assistant to the Secretary of Defense. He will be in charge of "direction and coordination of research, development, engineering and production of guided missile activities," according to a department statement, as well as chairman of the department's Office of Scientific Development committee on ballistic missiles.

An important part of Mr. Murphree's new job will be coordination of the work in research and development by the three armed services. Its largest aspect, however, will be the over-all direction of ballistic missiles in the "intermediate" or 1,500 mile class, as well as the long-range missile of 3,000 miles and over.

Mr. Murphree was born in 1898 in Bayonne, New Jersey. He joined Standard Oil Company (New Jersey) in 1930 and became president of Esso Research in 1947. During World War II he was chairman of the planning board responsible for engineering and technical aspects of the Manhattan Project, which developed the atomic bomb.

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Rex Shaver

H. L. Rowley Elections

Rex Shaver was recently elected president and three others elevated to official positions in H. L. Rowley, Inc., drilling contractors headquartered in Shreveport, Louisiana.

Other organizational changes were the election of Stephen Rowley as vice president, promotion of Carl C. Kendrick to secretary-treasurer and appointment of W. H. Son as drilling superintendent.

H L. Rowley, the firm's founder, G D. Murray and Charles F. Hayes have resigned as president, vice president and secretary-treasurer respectively to devote their time to other business interests.

Promoted from assistant secretary-treasurer, Mr. Kendrick has been a member of the Rowley administrative staff for the past six years. Mr. Son, who has been a tool pusher in the Rowley organization since 1948, will direct drilling operations from the company's general offices at 244 Montgomery Street, Shreveport, Louisiana.

Dr. W. B. Hart

Hart Named To Pantech Post

Dr. W. B. Hart has been named director of the industrial wastes engineering division of Pantech, Inc., Folcroft, Pa., consulting engineers in chemical and biological treatment and disposal of industrial and sewage wastes. For more than 30 years Dr. Hart directed the activities of the waste control division of the Atlantic Refining Co. He was chairman of the committee for disposal of refinery wastes of the API from 1940 to 1946 and helped organize the committee in 1930.

Plan Ammonia Plant

Petroleum Chemicals, Inc., subsidiary of Continental Oil Co. and Cities Service Co., will build an ammonia plant at Lake Charles, La. The $12.5 million installation will produce 100,000 tons per year of anhydrous ammonia, primarily for agricultural purposes. Mid-South Chemical Corp., Memphis, will market the output. The plant will be on stream late in 1957.

Congress on Catalysis

The International Congress on Catalysis has announced its program for its meeting in Philadelphia, Sept. 10-14, 1956. Papers will be presented by 81 experts in this field. Of these, 47 come from the United States while the others are scientists from Europe, Asia and Africa. A list of papers and the other information may be obtained from Dr. H. Heinemann, executive secretary, The International Congress on Catalysis, P. O. Box 7686, Philadelphia 1, Pa.

Perched nine stories above the Mississippi River, this mammoth "portable island" has been purchased for $2 million from R. G. LeTourneau, Inc., of Longview, Texas, and is being fitted by its owner for off-shore oil drilling. The platform can be lowered to the water, floated from one operating site to the next, then quickly hoisted above the waves again.

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Richfield Plans Sulfur Expansion

Macco Corp. has been awarded contracts by Richfield Oil Corp. for the engineering and construction of two projects at Richfield's Watson Refinery at Wilmington, Calif. The two units are a diethanolamine regeneration unit and a water reclaiming unit. These plants will substantially increase Richfield's capacity for recovering hydrogen sulfide, which is subsequently converted to sulfur. The cost of these projects will run about $500,000.

Transcontinental 1955 Earnings

Net income during 1955 of Transcontinental Gas Pipe Line Corp. was $9,987,027, or $2.29 per share on common stock. This compares with $8,550,719 or $2.02 per share, for the previous year.

Natural gas delivered in 1955 was 211 billion cubic feet, 6% over 1954. Operating revenues for 1955 were $74,689,839. A major expansion program increased daily capacity about 25%.

Builds Polyethylene Plant

W. R. Grace & Co. has begun construction of a multi-million dollar polyethylene plant north of the city adjacent to the proposed Baton Rouge Barge Canal. Ground was broken on March 5. The polymer chemicals division which is building the plant is a new division of W. R. Grace & Co.

Receipts By Oil And Gas Contract Services

The 1954 census of Mineral Industries indicates that receipts for services by the oil and gas field contract services industries in 1954 amounted to $1.6 billion. Establishments primarily engaged in drilling oil and gas wells accounted for $920 million of these total receipts; establishments primarily engaged in building, repairing, or dismantling rigs and derricks, for $11 million; and establishments primarily performing other oil and gas field services, for $634 million.

De Witt Knox

Knox Named Vice President

De Witt Knox, has been named vice president and general manager of the J. B. Gill Co., integrated organization of civil, mechanical, chemical and petroleum engineers and constructors.

Southern Production Report

Southern Production Co., Inc. has reported a net income of $4,347,453 for 1955, equal to $2.52 per share, highest in the company's history. Net income was approximately 4% over 1954.

Crude oil revenues decreased 0.4% to $8,471,456. Natural gas revenues decreased 2.6% to $5,345,932, while revenues from condensate and plant products increased 4.4% to $2,921,226.

Net crude oil and liquids production averaged 11,605 b/d in 1955, an increase over the 11,068 b/d in 1954.

Drilling and Exploration Gross Up

Gross revenues for Drilling and Exploration Co., Inc. amounted to $11,535,433 in 1955, an increase of 16.6% over 1954. Net income for the year was $832,765 or 44 cents per share.

Reformer Corrosion

Unexpected corrosion problems have appeared in catalytic reformers and desulfurization units, it was reported to the March 15 meeting of the National Association of Corrosion Engineers at New York, in a paper by Gerard Sorell and W. B. Hoyt of The M. W. Kellogg Co. The corrosion stems from the high temperatures and pressures to which hydrogen sulfide is subjected in the equipment.

The nature of the corrosion differs sharply in two important aspects from that long experienced in processing sour crudes in older types of units, such as crude and vacuum distillation, thermal and catalytic cracking, thermal reforming and coking. Severe attack occurs at comparatively lower levels of sulfur content and, secondly, the chrome-moly steels heretofore considered effective in resisting "sulfur attack" offer no improvement over plain carbon steel, the Kellogg engineers reported.

Chrome-nickel stainless steels and aluminum coatings appear to be the only economic materials capable of withstanding this type of corrosive attack, it was stated. The authors have developed corrosion summary charts for equipment design that predict the variation of corrosion rate, with temperature, hydrogen sulfide partial pressure, and alloy content. These findings are derived from a wide variety of laboratory results, pilot plant tests and refinery experience obtained from the published literature and private sources.

Gulf $35 Million Construction

Gulf Oil Corp. has undertaken a $35 million construction program at its Philadelphia refinery. Emphasis will be on product improvement.

Principal units will be a 26,000-barrel Platformer, a 3,000 b/d sulfuric acid alkylation unit, two 20,000 b/d Gulfining (hydrogen treating) units, a 22,500 b/d vis-breaker, LPGas facilities steam plant, product storage and other facilities.

At Your Service at the API Convention ...and everywhere in Canada

Our representatives, John Trott and Joe Lalonde, will be on hand to extend a personal welcome from Canada's First Bank to delegates to the API Convention in Montreal.

You are invited to visit them at the B of M's suite at the Sheraton-Mount Royal or to call at any of our 60 branches in Montreal for any information or assistance that might add to your visit. Our branch at Peel and Burnside is right across the street from the Mount Royal, and our manager, Athol Horne, will be very happy to meet you.

John Trott

Joseph E. Lalonde

Canada's First Bank Knows Canadian Oil

With 650 branches coast-to-coast—and 241 branches in the oil Provinces alone—Bank of Montreal has been closely associated with Canada's oil development. B of M has helped many U.S. oil men "get acquainted" in Canada. Meet us while you are in Montreal . . . or write later to our representative in the oil fields:

J. Austin Richards, Special Representative, Bank of Montreal, Calgary Main Office, 140 Eighth Avenue West, Calgary, Alberta, Canada (Telephone 2-8333)

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Oil Burner Shipments

The market research department of the Oil-Heat Institute of America predicts the third biggest year in the history of the industry for residential oil burners and oil-fired furnaces and boiler shipments based upon 11-month totals for 1955.

Burners shipped separately for conversion from other fuels and replacements are up 13.8% over the same 11 months in 1954; oil-fired warm air furnaces are up 6.7% and boiler-burner units are up 17.1%. The combined burners and units are up 10.2%. For the first 11 months of 1955, total shipments reached 773,818. It is expected that the grand total of unit shipments will reach 820,000 in 1955. Commercial-Industrial oil burner shipments have also been heavy throughout 1955, with a total for the 11 months of 32,075. The number of units is off slightly from 1954, but with larger sizes showing a definite increase.

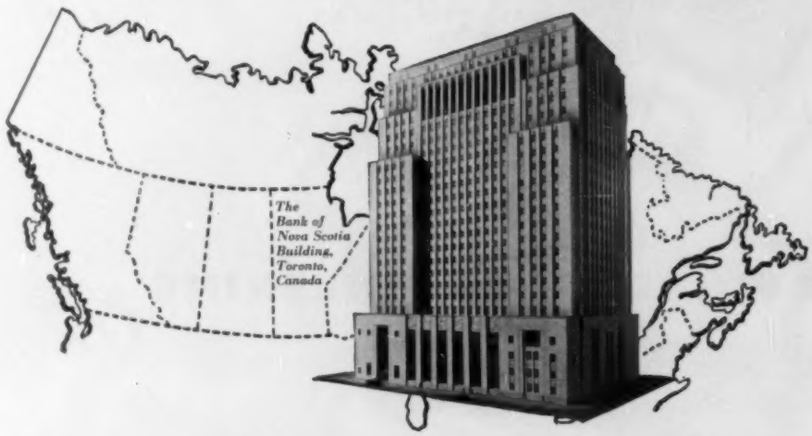
To Build Gasoline Plant

A 25-million cubic foot gasoline plant will be built on the Roberts Ranch in Midland county, Texas, by Cities Service Co. and associates. The plant will be designed for ultimate expansion to 50 mmcf when development of the ranch is completed in 1960. There are now 76 wells on the ranch.

J. L. Irwin

J. L. Irwin of Edmonton died in Calgary on April 15. Born in India, he came to Alberta just before the first World War, served with the 49th Battalion and was wounded at Vimy Ridge in 1917. For some time he was employed by the Department of Lands and Mines of Alberta, retiring in 1946. Since then he has been a very active correspondent for a number of magazines, including WORLD PETROLEUM. He leaves a wife in Edmonton and two sisters in England.

Canada offers you opportunity



and here is the international bank to help you

THE soaring output of the Albertan fields is little more than an indication of Canada's oil potential. The development and financing of this potential offers one of the most exciting opportunities in the history of the petroleum industry.

The Bank of Nova Scotia, with more than 400 branches in Canada, Great Britain, the U.S.A. and the West Indies, and with correspondents wherever men trade, offers all the advantages of a truly International Bank to all who are interested in Canada's oil boom. It is equipped to give authoritative information and expert guidance on any of the many banking and financial problems confronting the oil man.

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In Dominican Republic: Ciudad Trujillo, R.D.
In Trinidad: Port of Spain.

And correspondents all over the world

J. Robert Kelley

Kelley Elected President

J. Robert T. Kelley has been elected president of Manning, Maxwell & Moore, Inc., succeeding Hamilton Merrill, who has retired. Manning, Maxwell & Moore is a manufacturer of many types of industrial products, including pressure gauges, valves, and electronic instruments.

Eugene T. Singer

Eugene T. Singer, 69, former vice president and director of Standard-Vacuum Oil Co., died March 2nd at St. Petersburg, Florida. Mr. Singer retired in 1949 after 37 years in the industry, during which time he became a recognized expert on financial problems and foreign exchange, particularly as related to the Far East, Australia and Africa.

Entering the oil industry in 1912 as an accountant with Standard Oil Co. of New York, his first assignment was at Hong Kong. After serving there as chief accountant he returned to New York in 1924 to join Socony's foreign accounting department. Later, as assistant controller, he travelled throughout the Far East reorganizing the financial and accounting procedures of company offices in that area.

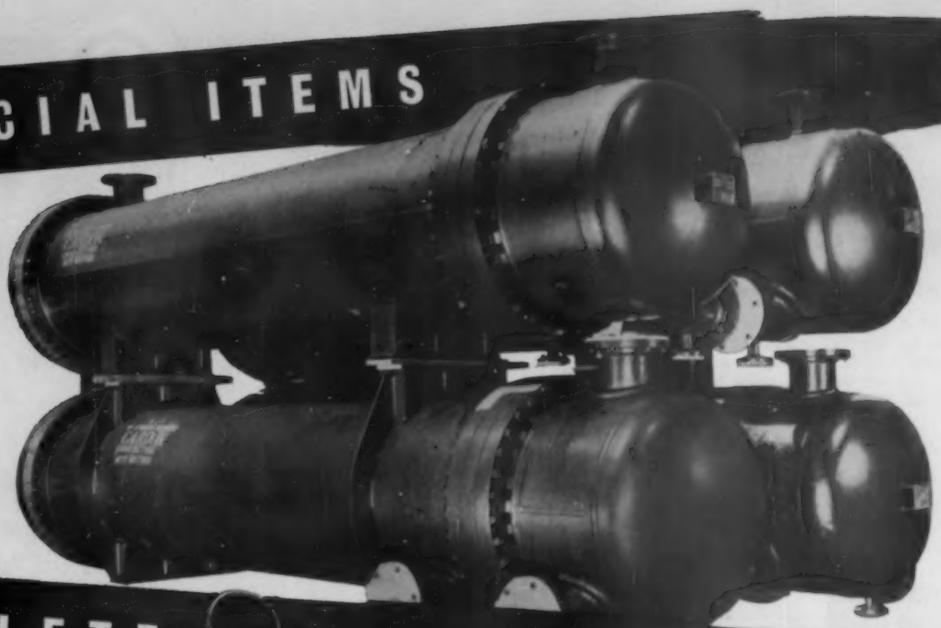
When Standard-Vacuum Oil Co. was formed in 1933, he became its first treasurer and chief financial officer. In 1939 he was elected to Standard-Vacuum's board, and three years later was named senior vice president. He devoted much of his time to the development of the company's employee benefit plans, and played a leading part in the rehabilitation of Standard-Vacuum facilities in the Far East after World War II.

J. W. McCormick

Appointed Assistant Sales Manager

Pacific Pumps, Inc., Huntington Park, Calif., has appointed J. W. McCormick as assistant sales manager, centrifugal pumps division. He previously was Pacific's New York district manager and has been with the firm since 1941. W. S. Eadie, formerly sales engineer in Pacific's New York and Chicago offices, has been named New York district manager to succeed Mr. McCormick.

SPECIAL ITEMS



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COMPLETE REFINERY UNITS

• A Platformate Splitter-column and ancillary plant at the B. P. Kent Oil Refinery, Isle of Grain.

AT HOME OR ABROAD

• A Heavy-cycle Oil Stripper for Compañía Shell de Venezuela.

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W. J. FRASER & CO. LTD., CHEMICAL & PETROLEUM ENGINEERING CONTRACTORS, HAROLD HILL, ROMFORD, ESSEX. WORKS: MONK BRETTON, BARNSLEY, YORKS.

600 Offshore Wells in 1956

Around 600 offshore wells will be drilled in the Gulf of Mexico during 1956, Felix E. Wormser, assistant secretary, Department of Interior, told the annual meeting of the North Texas Oil and Gas Association. Offshore producing oil and gas wells at present number about 600. Around 360 were drilled during 1955, of which 53 were wildcats. The discovery ratio was extraordinarily high, with one producing well for each two dry holes.

Dresser's First Quarter Net Up

Net earnings after taxes of Dresser Industries, Inc., Dallas, Texas, for the first quarter of 1956 were $3,274,000, compared with $1,809,000 during the first quarter of 1955. On a per common share basis, net earnings were $1.64, 80% over the corresponding quarter of 1955.

The world's largest helicopter, the United States Air Force's XH-17 heavy duty cargo transport, successfully completed a rigid test program recently by lifting a trailer van weighing 7,800 pounds.

Marvin Gwinn

Heads Security Advertising

Marvin Gwinn has been appointed director of advertising for Security Engineering Division of the Dresser Industries according to an announcement by A. M. Birnie, vice president in charge of sales. This is a newly-created post preparatory to heading up the firm's advertising division. Mr. Gwinn joined Security in 1955, doing field sales work in West Texas. He formerly was assistant advertising manager of Shamrock Oil and Gas Corp., Amarillo, Texas, and more recently vice president of a Dallas advertising agency.

Esso Budget Expenditures Up

Capital investments in Esso Standard Oil Company's 1956 budget total $126,600,000—highest annual figure in the company's history. About $16 million in this year's capital budget is for chemical-products projects. The largest single item of investment—about $35,500,000—is for new or improved equipment for making gasoline, heating oil and other fuels at the company's six refineries.

The budget provides an additional $18 million investment for the company's long-range service station program. About $3 million is for new harbor facilities, to handle the new and larger super-tankers. More than $1 million is for safety items or to reduce air pollution.

In all, $86,100,000 has been earmarked for manufacturing, 17½% above the previous high of $73,300,000 spent in 1954. Marketing's allocation of $34,800,000 is 3½% above the $33,600,000 spent in 1955, the former top annual figure. The marketing and manufacturing outlays account for about 95½% of the $126,600,000 budget total. Other items added up to $5,700,000.

Sidney Powers Medal to Wrather

William Embry Wrather, former director of the United States Geological Survey, has been chosen to receive the Sidney Powers Memorial Medal, highest honor in the science of petroleum geology, according to G. M. Knebel, president of the American Association of Petroleum Geologists. The gold medal and scroll recognize distinguished and outstanding contributions to, and achievements in, petroleum geology.

William E. Wrather was a founder of the American Association of Petroleum Geologists, and served as secretary-treasurer in 1918 and president in 1922.

New Tire by Firestone

A new tubeless tire, announced as the "safest and longest-wearing passenger car tire ever offered to American motorists" has been developed by Firestone Tire & Rubber Co.

It has a gummy sealant that prevents air leakage by flowing into and sealing small cuts and holes in the tire body. Blowout protection is assured by a safety diaphragm and a safety valve that automatically locks two-thirds of the air into its inner air chamber when the outer casing of the tire is ripped open or slashed.

Explorers are still
"discovering" Canada
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NEW-FOUNDLAND
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The men who first marked out the vastness of Canada—men like Cartier, Champlain, Hudson, Frazer and MacKenzie—have passed down the iron of their will to a new breed of discoverers.
Today's explorers may fly a helicopter to the heart of the Rockies, or break a highway through a forest at the throttle of a bulldozer, or dredge a seaway from the Great Lakes to the Atlantic.
All things that strength and enterprise can accomplish seem possible to Canadians. These fifteen million people form the world's fourth greatest trading nation—a nation that The Canadian Bank of Commerce has grown with since Confederation. Today the Bank has over 700 branches to serve Canada.
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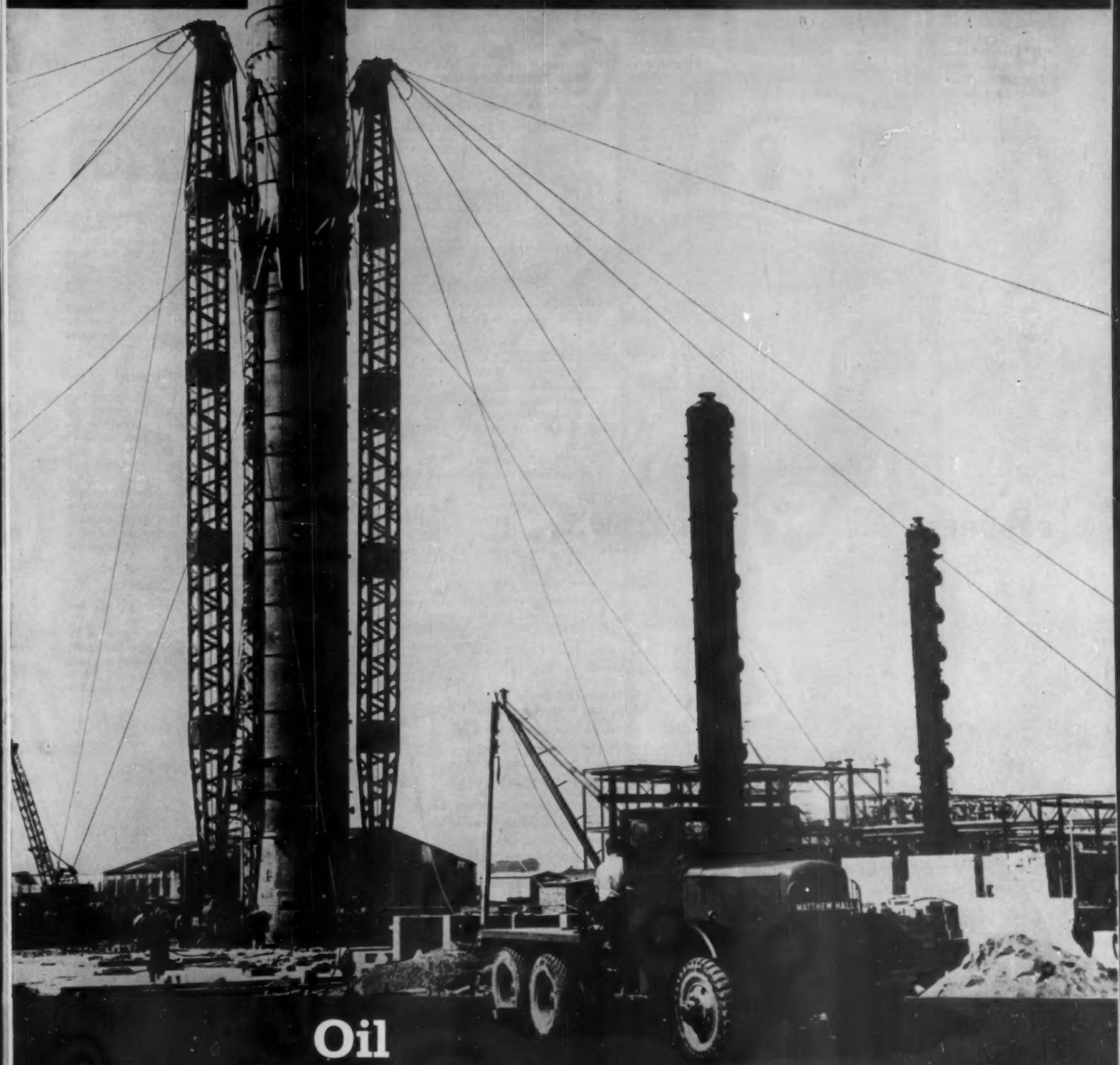
of Companies undertake engineering contracts in all parts of the world for the construction of oil refineries. The best of to-day's techniques backed by over a hundred years' engineering experience are available through the Group's designers, draughtsmen, technical buyers, administrators and engineers.



Oil refinery engineers

MATTHEW HALL

Petroleum and Natural Gas

(*Continued from page 97*)

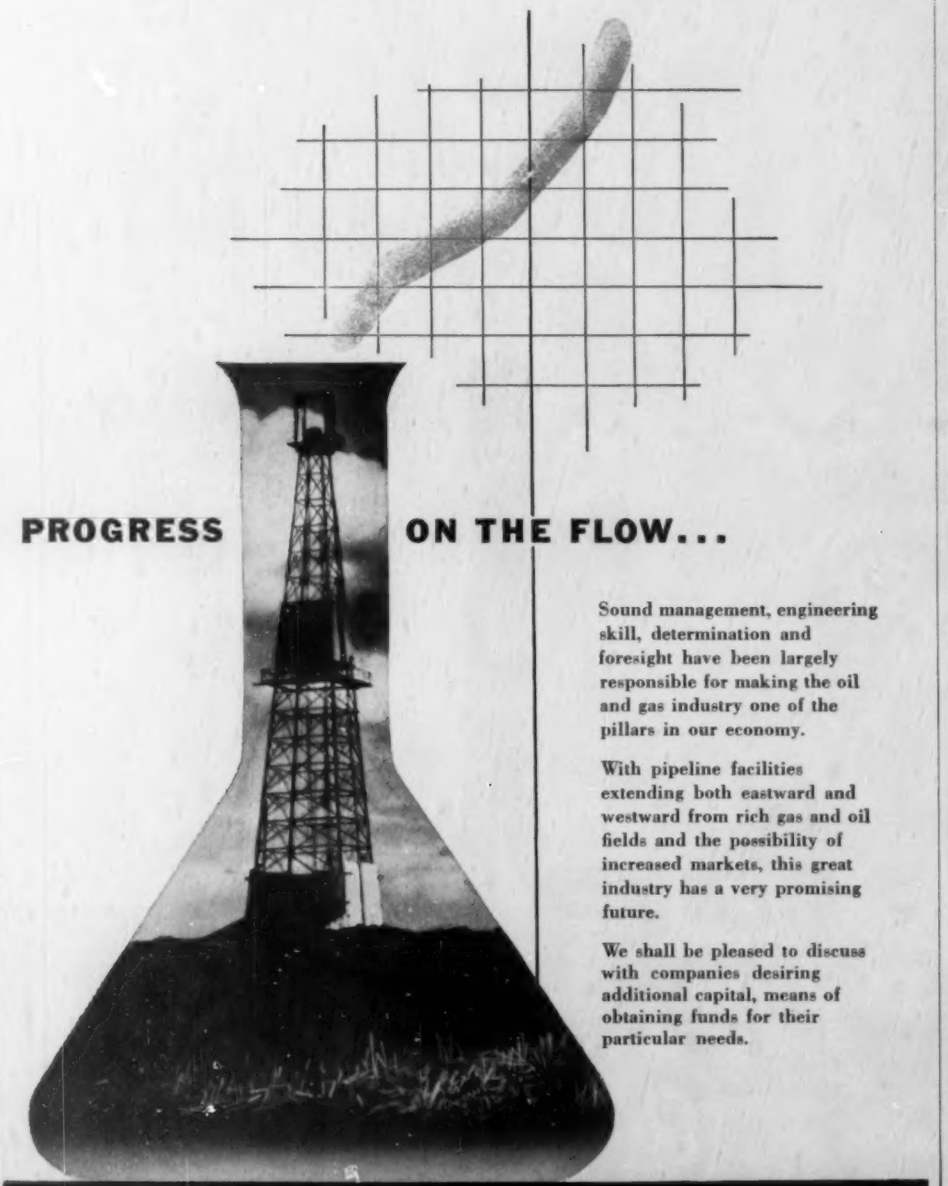
bearing reef rocks in these beds must not be overlooked. Some oil has been found in granite wash material lying on basement rocks in northwestern and north central Alberta. Oil may occur in a similar association with basement rocks in part of northeastern British Columbia.

The results of exploratory wells drilled in northeastern British Columbia do not strengthen the possibility of finding large oil discoveries in Mesozoic beds. The best prospects for oil may well be in the Devonian and deeper beds, thus far tested in only a few places. This may also apply to that part of northeastern British Columbia west of the Interior Plains.

HOWARD D. HENDERSON, manager of the Gulf Coast division, Sohio Petroleum Co., Houston, has been appointed coordinator of foreign operations. He will also assist Rudolph W. Edmund, assistant to the vice president in charge of exploration. The post of coordinator of foreign operations has been created because of the company's growing interest abroad. It now has operations in Guatemala, Venezuela and Iran.

CHARLES S. ATWELL, vice president of South America Gulf Corp., a subsidiary of The Texas Co., and for many years head of all foreign construction work for Texaco, has been elected chairman of Mile High Oil Co., Inc., Denver.

VERNON BLAIN, executive vice president and drilling superintendent of John Drilling Co., Fort Worth, has been elected president. John St. John, vice president, succeeds him at Odessa.



PROGRESS ON THE FLOW...

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With pipeline facilities extending both eastward and westward from rich gas and oil fields and the possibility of increased markets, this great industry has a very promising future.

We shall be pleased to discuss with companies desiring additional capital, means of obtaining funds for their particular needs.

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Edward C. Borrego

EDWARD C. BORREGO has been appointed general manager of Libyan American Oil Co., a wholly-owned subsidiary of Texas Gulf Producing Co. He was associated for over 28 years with the Standard Oil Co. (N. J.) in executive and technical capacities assigned to various Jersey affiliates in South America, Mexico and Europe.

During the war he was a major with the United States Forces and immediately after the war he served as petroleum attaché and advisor to the State Department.

Ammonia Plant on Stream

Sun Oil Co.'s new $10 million ammonia plant has been put on stream at Marcus Hook, Pa., according to an announcement by W. T. Askew, refinery manager. With a design capacity of 300 tons per day, the new ammonia plant is the largest of its type in the United States to operate on by-product hydrogen from reforming operations.

The ammonia plant embraces five different process systems. These include an air liquefaction and separation plant, two complete and separate refrigeration systems, a hydrogen purification section and a synthesis loop where the gases are combined and converted to ammonia.

Cummins Increases Capacity

Cummins Engine Co., Inc., Columbus, Ind., has announced a $6 million capital program for 1956, including construction of a 73,000-square-foot addition to its manufacturing plant. Cummins has spent $11 million since 1951, when its first major plant expansion program was initiated. Sales rose 36.9% in 1955 and an additional increase of 17% in capacity will be made.

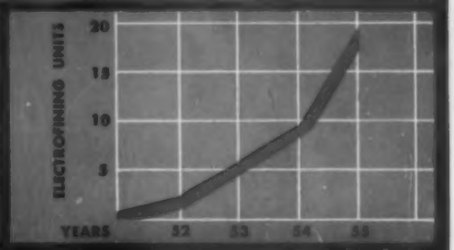
F. L. Tyler

F. L. TYLER has been appointed manager of Reed Roller Bit Co.'s European subsidiary, Reed Roller Bit Co. (Nederland) N. V. Mr. Tyler was formerly Reed's Pacific Coast sales division manager in Los Angeles.

WHY THE ACCELERATING INTEREST IN ELECTROFINING

In 1950 the first Petreco Electrofining* Unit was installed. Now there are 18 Electrofiners installed and — at the last count — six more under construction and on order.

**Petreco Electrofining is a compact, automatic, fast treating process for continuously contacting a light hydrocarbon stream with a treating agent, then rapidly separating the chemical from the treated product.*



THIS TABLE SHOWS THE WIDE ACCEPTANCE AND APPLICABILITY OF *ELECTROFINING*.

ELECTROFINING INSTALLATIONS

Refinery Location	Electrofining Treatment	Number of Units	BPD Capacity	Stock Treated
California	Acid	1	16,000	Light Pressure Distillate
California	Acid	4	8,500	Lube and Spray Oils
Indiana	Caustic	1	10,000	Blended light cycle oil and straight run naphtha
Kansas	Doctor	1	11,000	Straight run and cracked gasoline
Pennsylvania	Caustic**	1	12,500	Gasoline
Pennsylvania	Caustic**	1	3,600	Gasoline
Texas	Caustic**	2	5,000	Thermally cracked distillate
Texas	Caustic**	2	5,000	Cat distillate
Texas	Caustic**	3	30,000	Cat distillate
Texas	Acid	1	4,430	Lube Oil
Texas	Sulfonation	1	2,000	Virgin distillate
Texas	Dewatering	2	6,000	Vacuum Tower Gas Oil

**Caustic Scrub and Water Wash

Additional Electrofiners are under construction or on order for refiners in Canada, Pennsylvania, New York, Ohio, and New Jersey.

HERE ARE THE REASONS WHY MORE AND MORE REFINERS ARE SPECIFYING ELECTROFINING FOR LIGHT OIL TREATING:

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2. Continuous
3. Precision Controlled
4. Minimum Carry-over
5. Less Treating Chemical Used
6. Eliminates Haze Stabilizers
7. Fast-Tower to Market
8. Efficient—Removes Tarry Acids, Spent Caustic, Metals, Mercaptans and other Impurities
9. Flexible—Single, Dual, Two Phase Units Available
10. Automatic—Minimum Operating Attention Required
11. Costs Less than any Comparable Process

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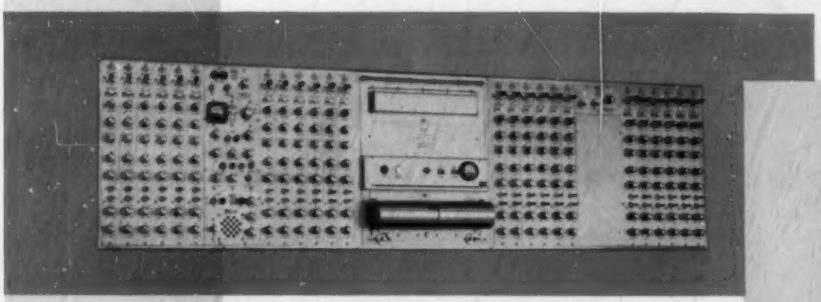

G-33 Full Spectrum
SEISMOGRAPH SYSTEM

SIE GA-33 Geophysical Amplifiers installed in an SIE G Series Seismograph System result in the widest range of recording applications ever offered the geophysical industry. In this small package are combined facilities for recording Refraction, Reflection, and High-Frequency seismic records . . . allowing the petroleum geophysicist to cover the entire seismic spectrum from 4 to 600 cycles-per-second with just one instrument.

Since the G-33 replaces three separate systems, it **cuts instrumentation costs in half!** In addition, SIE G-22A Seismograph Systems can be converted to Full-Spectrum operation simply by substituting plug-in GA-33 amplifiers and exchanging galvanometers . . . another example of SIE design forethought that lowers equipment costs for the industry's leading geophysical organizations.

ESSENTIAL TO A COMPLETE GEOPHYSICAL PROGRAM

Although SIE G-33 equipment exceeds any other seismograph in its capabilities and range of applications, it occupies only half the space required by many conventional single purpose instruments. With adaptability to every seismic exploration method, outstanding operating flexibility, and maximum field utility in terms of size and weight, the G-33 Full-Spectrum Seismograph System meets every requirement of modern exploration programs.

The GA-33 Geophysical Amplifier features Full-Spectrum filtering, variable AGC time-constants, and extremely low distortion (less than 1%). Its wide range is especially useful in magnetic recording applications, while plug-in construction permits simple installation and easy maintenance.

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Pacific manufactures a complete line of cast Carbon Steel and Corrosion Resistant Gate, Globe and Check Valves with Trim materials and Packing materials to suit your particular requirements.

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FOR ALL PURPOSES
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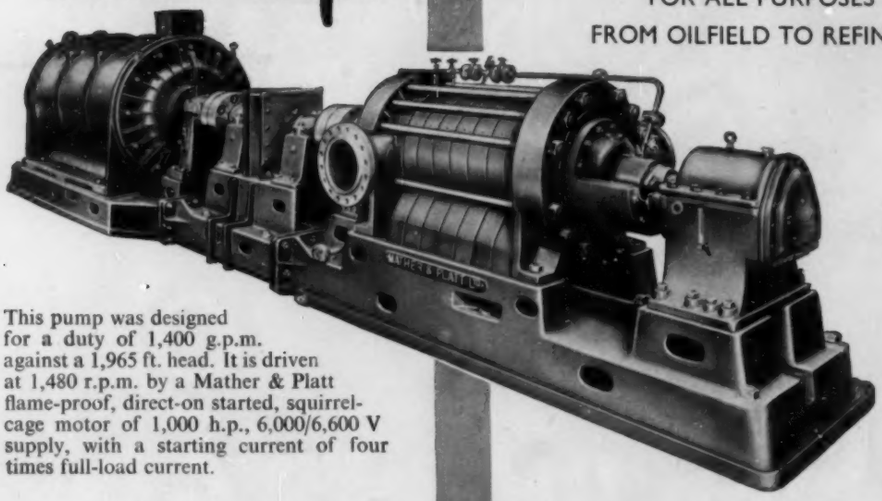
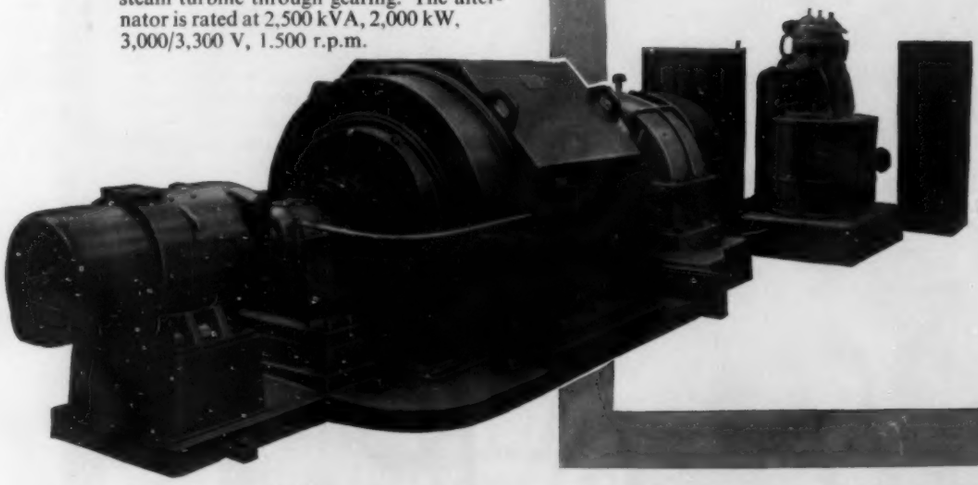


This pump was designed for a duty of 1,400 g.p.m. against a 1,965 ft. head. It is driven at 1,480 r.p.m. by a Mather & Platt flame-proof, direct-on started, squirrel-cage motor of 1,000 h.p., 6,000/6,600 V supply, with a starting current of four times full-load current.

A duct-ventilated alternator coupled to a steam turbine through gearing. The alternator is rated at 2,500 kVA, 2,000 kW, 3,000/3,300 V, 1,500 r.p.m.



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BRAZIL * Cubatao ‡

FRANCE
Port Gerome. Du Nord (Dunkirk)
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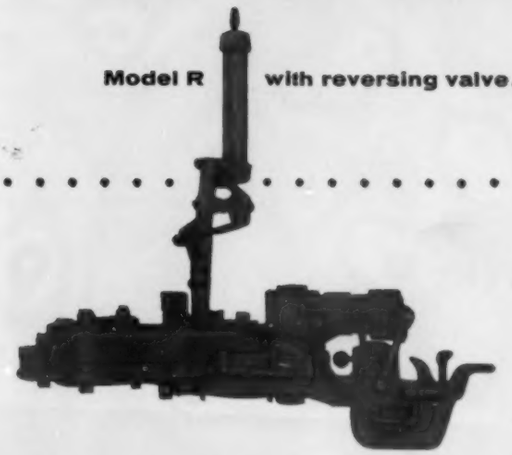
introducing a New lighter-weight, low-priced BJ Hydratorc

Byron Jackson — first name in the manufacture of power drilling and production tools for the oil industry — now adds a *new* model to the Hydratorc line of hydraulic tubing tongs. Designed to effect savings in weight, the new Model S offers the time-proven operating efficiencies of the BJ Hydratorc at a lower cost. The reduced weight contributes to easier handling and the popular BJ roll-over feature is provided for "reverse" operation. All of the dependability of BJ Red Iron is built into this new addition to the Hydratorc line. It's another step in the continuing BJ program of putting *more* power to work for you.

Model R with reversing valve...



The Model R Hydratorc has both the roll-over feature for quick convenience in testing joints or changing couplings plus a four-way valve for "reverse" operation in an upright position — especially useful when breaking out long strings of tubing.

Byron Jackson

Division of Borg-Warner Corporation

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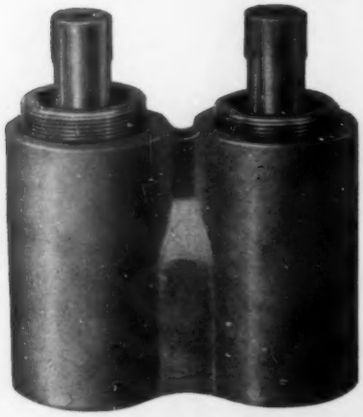

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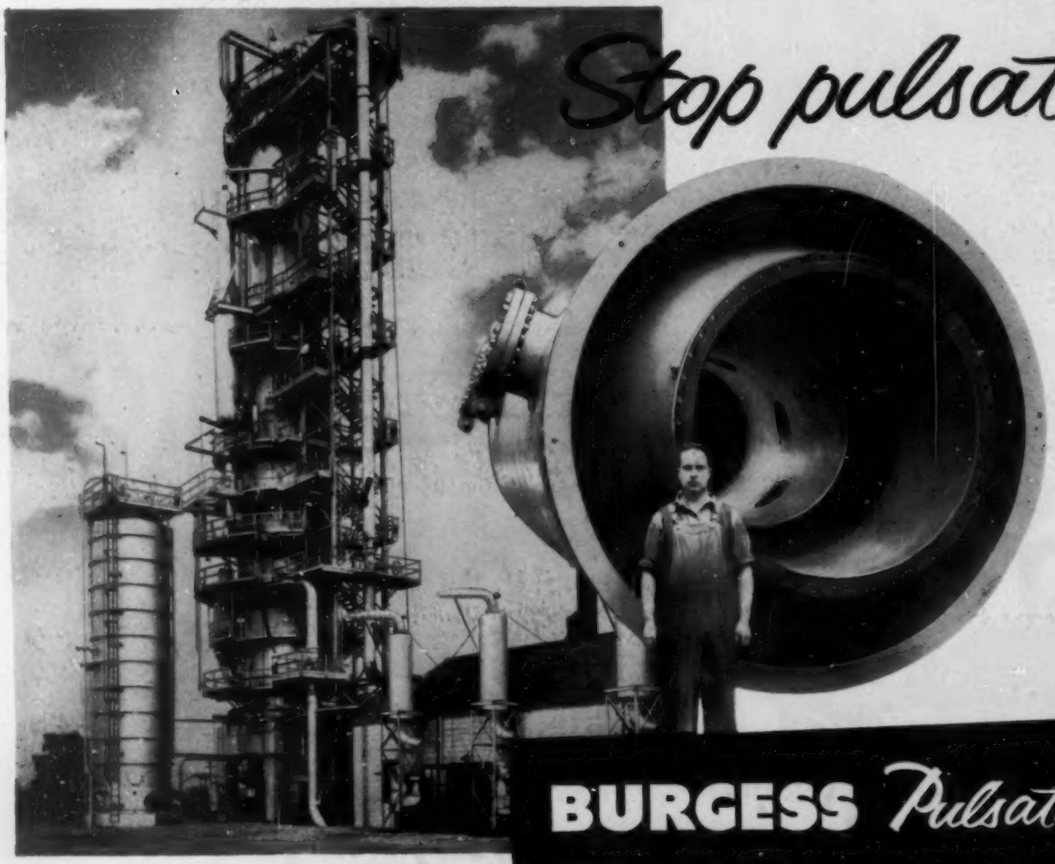

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Oscilloscope recording shows pulsation (left) and smooth flow attained after fitting BURGESS Snubber (right).

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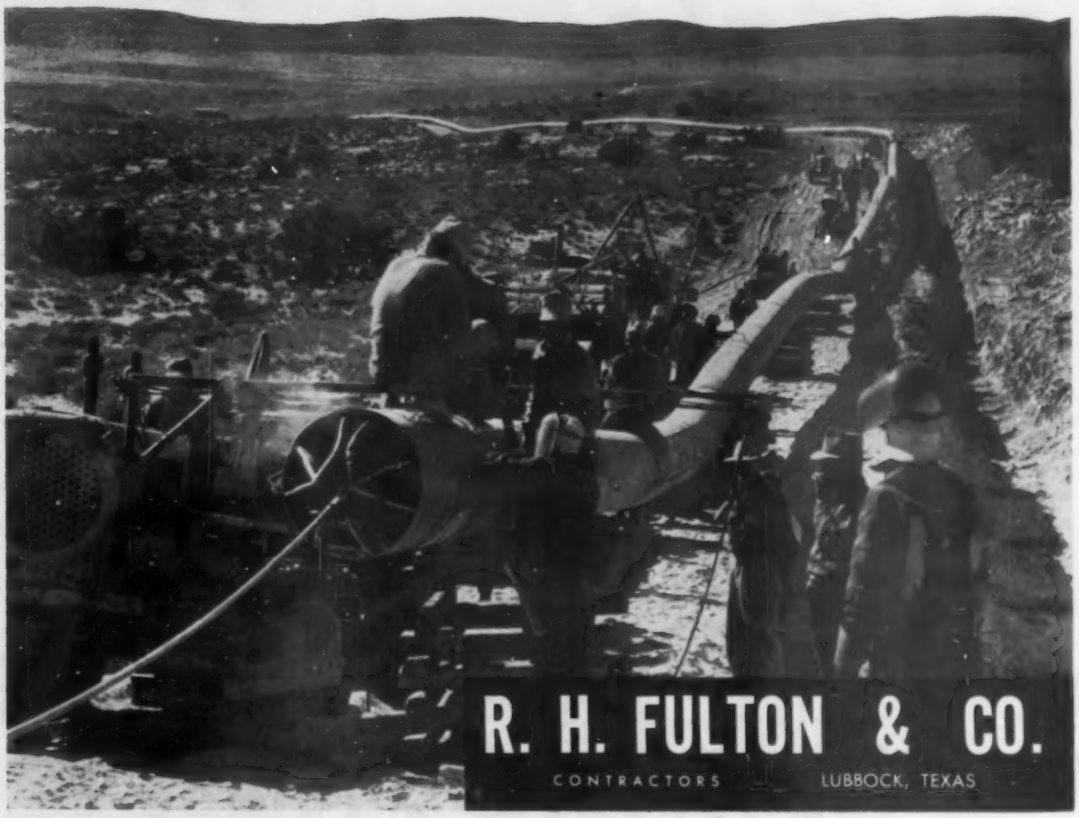

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Review Of British Borneo

The British Malayan Petroleum Co.'s field at Seria produced an estimated 113,448 b/d during February 1956, plus around 131 b/d of natural gasoline recovered from oilfield gas by a process plant. Seria's total production for 1955 was 105,753 b/d (compared with 98,151 b/d in 1954), about 8% of the total being heavy oil and the remainder light. A total of 34 new wells was completed in Seria during 1955, all of them producers, and at year's end the field was producing from 292 wells. 1955's completions involved the drilling of 209,900 feet of hole.

The B.M.P. Co. obtained a small show of oil late in 1955 at Jerudong, a jungle area midway between Seria field and Brunei Town, the State capital, and between October and the year's end about 3,500 barrels was run off on production tests. There was no production from Jerudong in January, 1956, but a further 3,500 barrels was taken during February on production tests. It is officially stated that it is too early to assess Jerudong, but it is noteworthy that the area has produced the first encouraging oil show in nearly 20 years of exploration in British Borneo.

In Sarawak, the declining field at Miri operated by Sarawak Oilfields Ltd. produced about 1,396 b/d during February, 1956, and the same approximate amount during January. Miri's production for 1955 was 1,290 b/d (compared with 1,378 b/d in 1954); no new wells were drilled in 1955, but 171 old wells continued to produce.

In North Borneo, Shell Co. of North Borneo is continuing limited exploration work, so far without result.

British Borneo consists of the Colonies of Sarawak and North Borneo and the Protected State of Brunei, a small (20,000 sq. mile) Sultanate sandwiched between the two. The three operating companies reviewed above are all Shell Group associates, and have worked in the area since Miri field was discovered early this century. Seria was discovered in about 1930, but to date there have been no significant discoveries in North Borneo.

The three companies cooperate in their exploration efforts, and between them drilled 12 wildcats during 1955, involving 53,913 feet of hole. Seven of the wildcats were dry, one—at Jerudong—showed promise, and the remaining four were still drilling at year's end. (All have subsequently been abandoned as dry).

At Seria, recent developments include the building of four marine drilling platforms at distances ranging from 1,000 feet to one mile offshore. Three platforms are connected to the coastline by aerial ropeways, and the fourth by a Bailey Bridge boardwalk. From two of the platforms, four wells have been drilled from each into the bed of the South China Sea with success, a seaward extension of Seria field having been tapped. As at the beginning of March, 1956, drilling was in progress from the third platform, and the fourth (the closest inshore, with the Bailey Bridge boardwalk) was rigging up. Further marine drilling developments are to be expected at Seria during the next few months.

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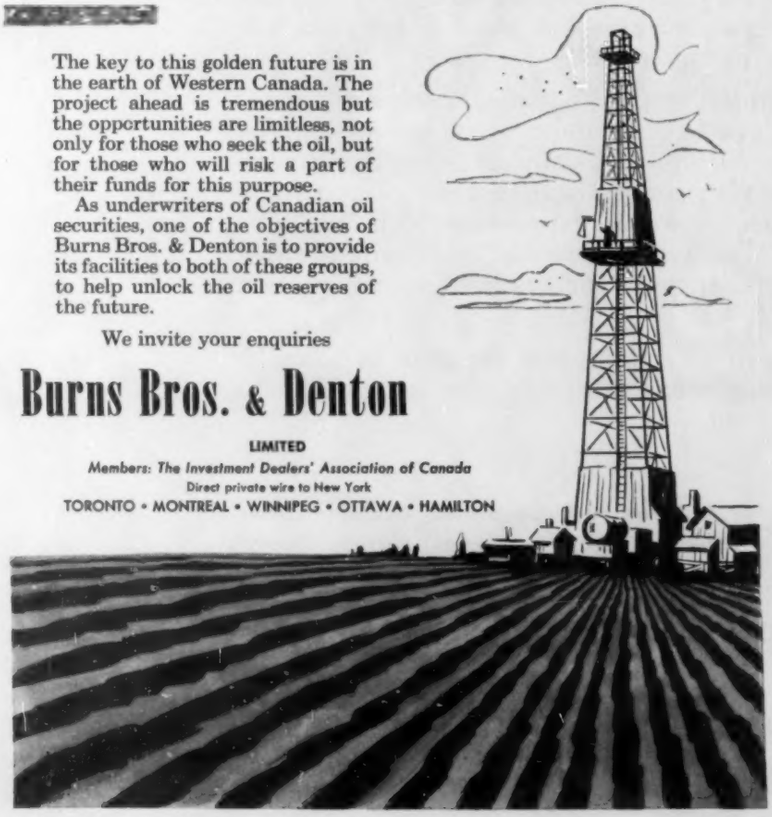


Russia Claims Cracking Invention

The oil cracking process was invented by three Russian scientists in the middle of the last century, according to the Hungarian newspaper, *NEPUJSAG*, of January 19, 1956, which also states that the Russian engineer Souhov later brought the invention to perfection in 1890.

Exploration In Sarawak

Two wildcats have been spudded in Sarawak, British Borneo, during March by Sarawak Oilfields, Ltd., the Shell Group associate. One is at Semilijau, on the coast in the Fourth Division of Sarawak, about 70 miles south of the existing field at Miri. The other is at Balingian, Third Division of Sarawak, another 60 miles further south. The location here is about 18 miles up the Balingian River.

Both exploration wells are in continuation of S.O.L.'s program for investigation of several promising-looking formations along Sarawak's coastline.

Consumption In South And West Africa

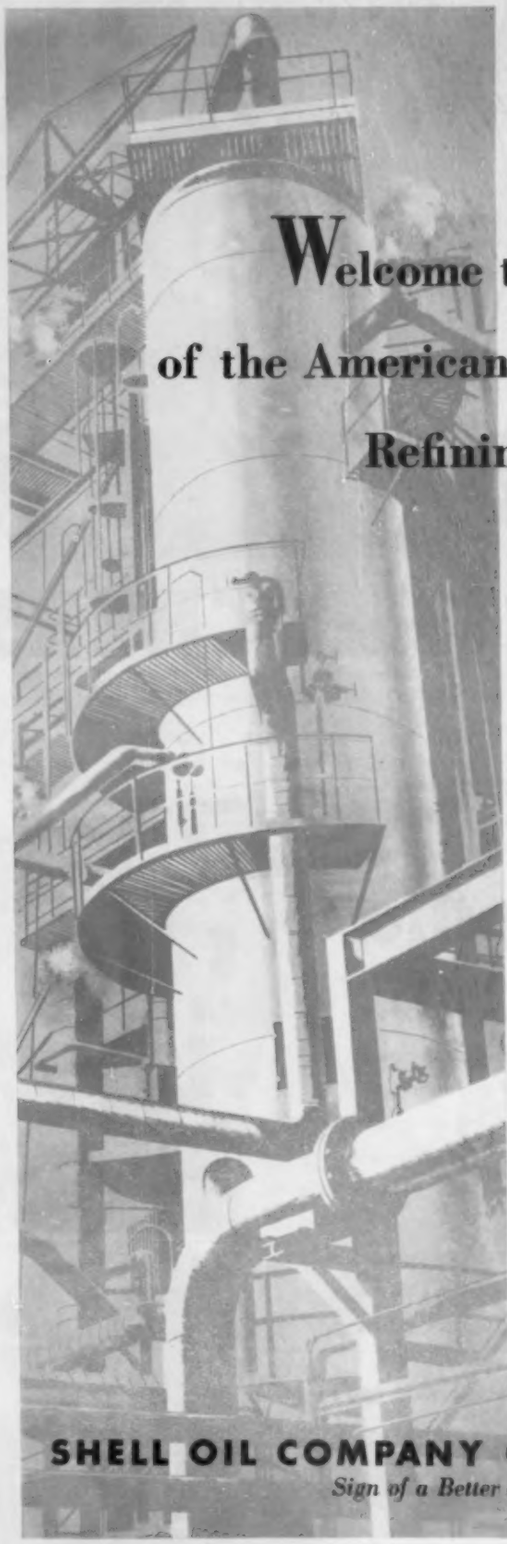
Consumption of petroleum products rose by 1,458,200 barrels in 1955, up 7.1% over 1954, in Union of South and West Africa. Figures are as follows:

	(Thousands of Imperial Gallons)	
	1954	*1955*
Aviation Gasoline	8,240	8,755
Motor Gasoline	373,425	398,675
Power Kerosene	91,220	90,160
Illuminating Kerosene	45,738	48,400
Diesel Gas Oil	82,480	102,315
Industrial Diesel & Furnace Oil	15,500	14,725
Bunker Diesel	25,800	27,135
Bunker Fuel	61,500	64,275
Lube Oils	23,000	24,150
Greaser	3,000	3,164
	729,904 (20,854,000 bbls.)	781,854 (22,338,685 bbls.)
Division of Retail Oil Sales		
Shell Co.	31.4%	30%
Vacuum Oil Co.	26.65%	29.5%
Caltex	22%	22%
Atlantic	17.6%	13.5%
Others	2.35%	5.0%

The South African Coal and Gas Corp., meanwhile, hopes to turn out 40 million gallons of motor fuel and 7,200,000 gallons of diesel oil annually, starting in 1956. The plant, which makes synthetic fuel from coal, would sell the products to the retail distributing companies listed.

The plant, 56 miles south of Johannesburg, turned out its first motor gasoline in 1955. Public investment in the plant is $112 million, compared with original estimates of $36,400,000.

(*Continued on page* 214)



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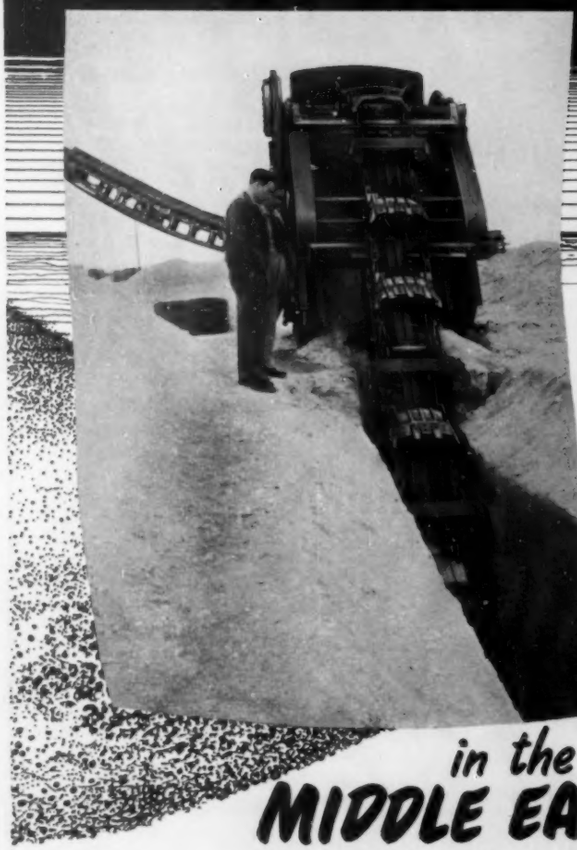

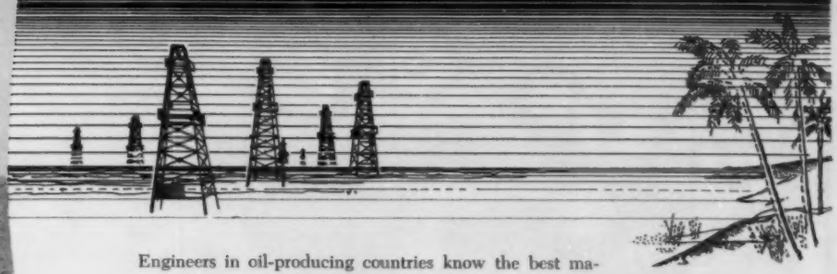

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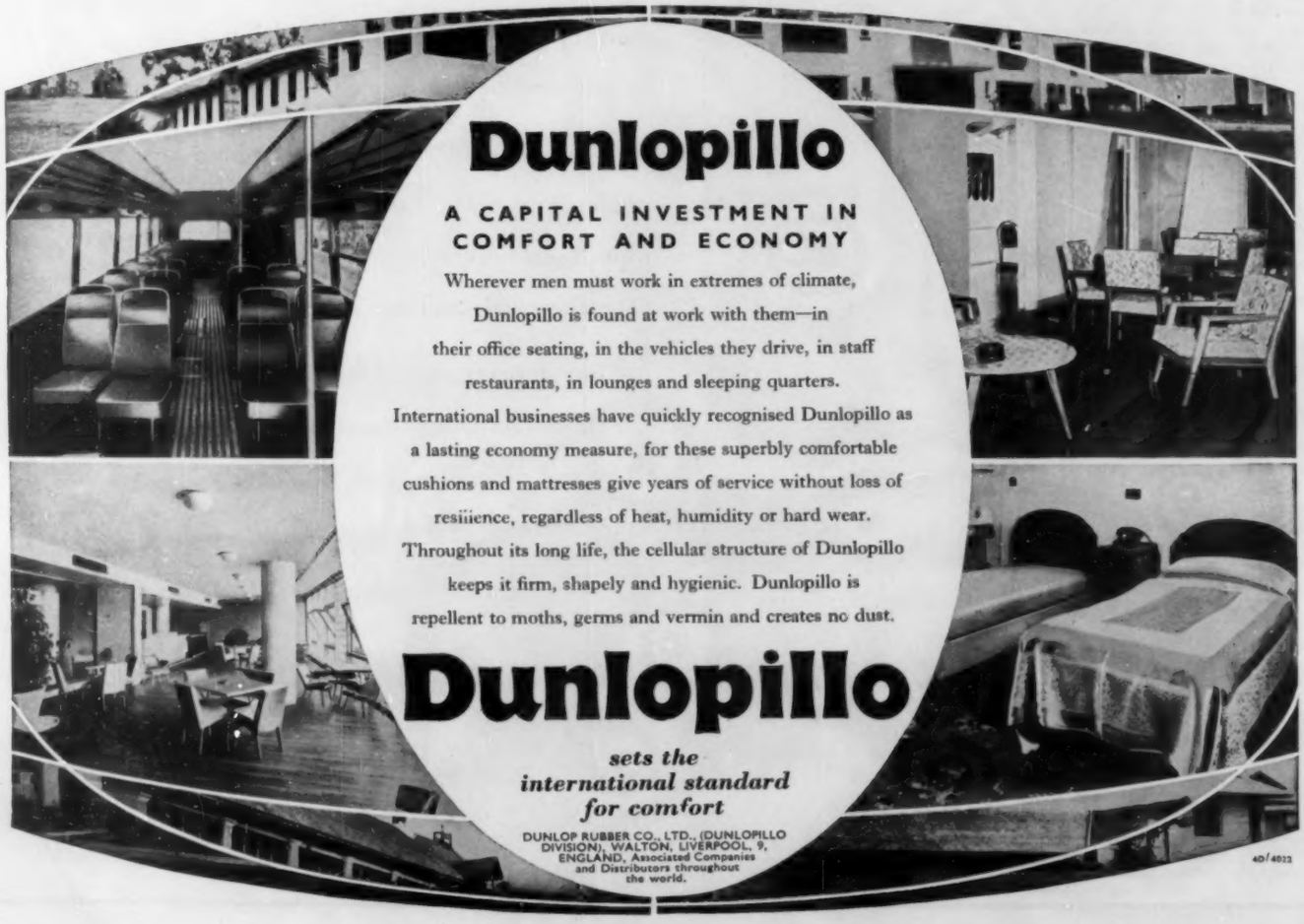

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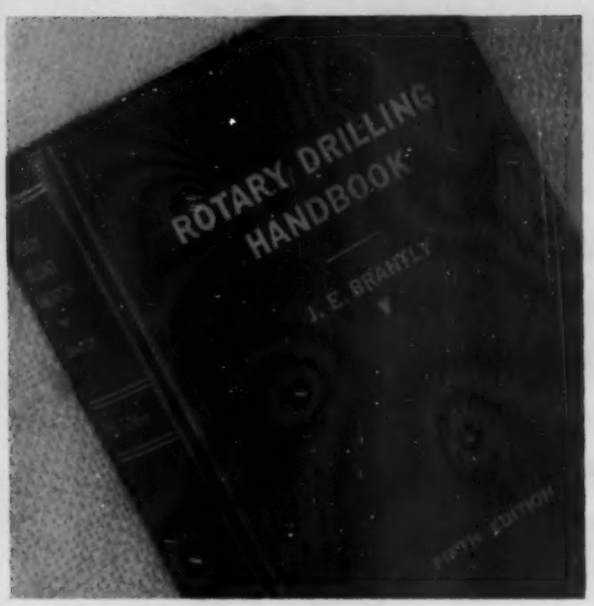

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CONTENTS

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II	POWER PLANTS	XVIII	STRAIGHT HOLE DRILLING
III	CIRCULATING PUMPS	XIX	INSTRUMENTS
IV	DERRICKS AND MASTS	XX	DIRECTIONAL DRILLING
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VII	FIELD CONTROLS	XXIII	FORMATION TESTING
VIII	DERRICK EQUIPMENT	XXIV	HOLE SIZES AND WELL PROGRAMS
IX	LUBRICATION	XXV	SAFETY MEASURES
X	WIRE LINES	XXVI	GEOLOGY AND FORMATIONS
XI	DRILLING SHAFTS	XXVII	ACCOUNTING
XII	PIPE & DEPTH MEASUREMENTS	XXVIII	SUMMARY
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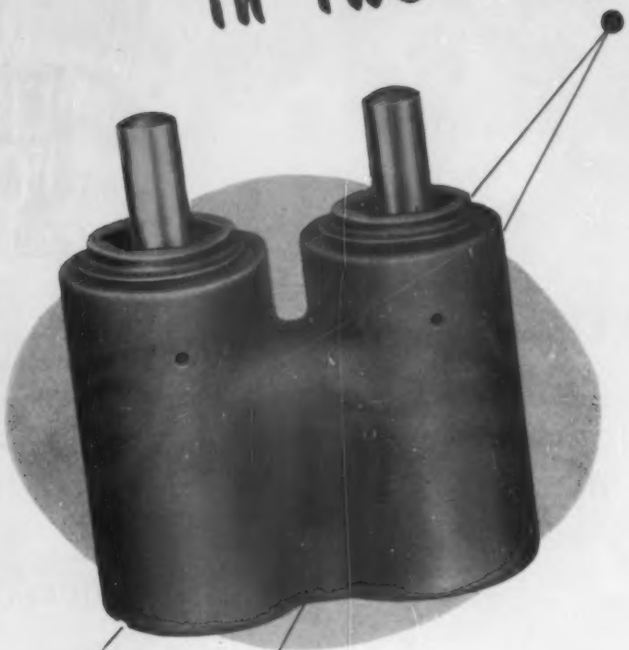

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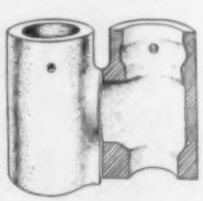

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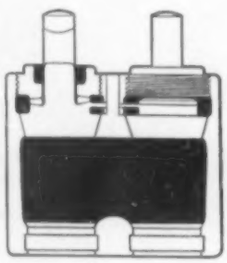

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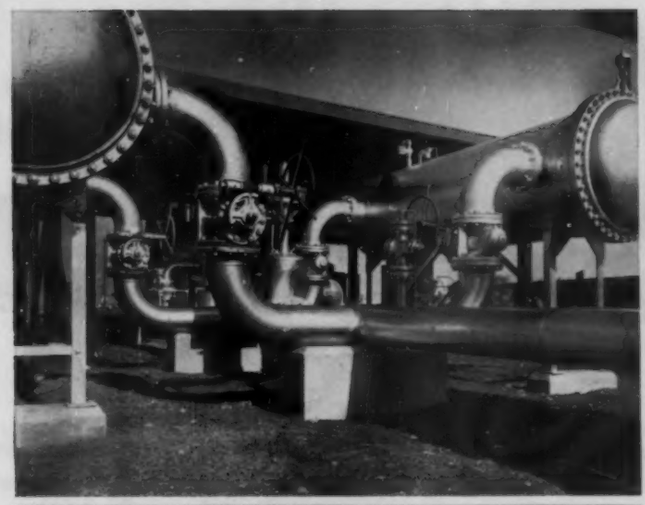

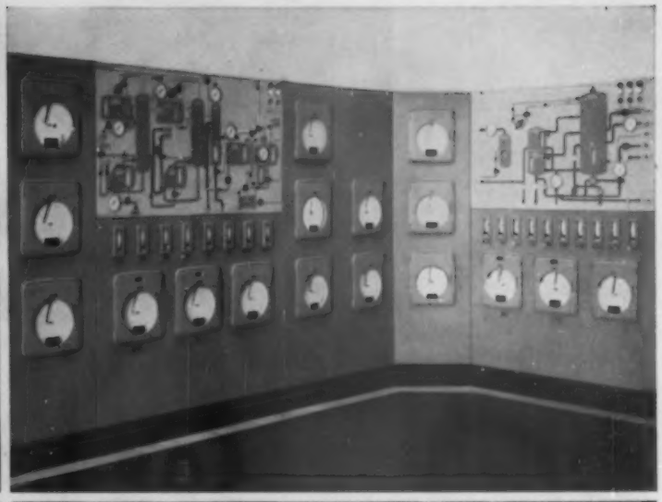

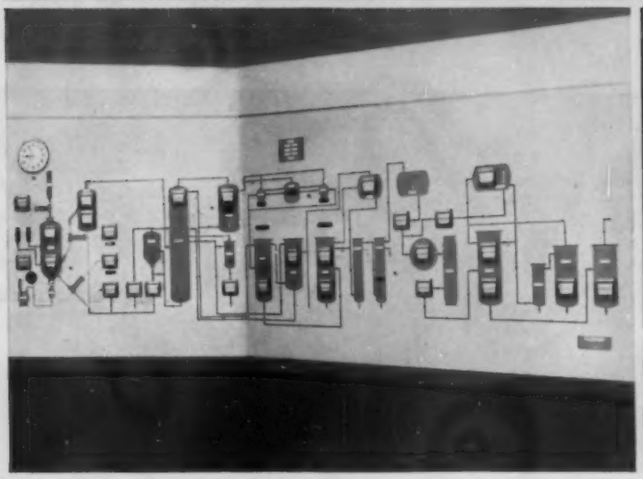

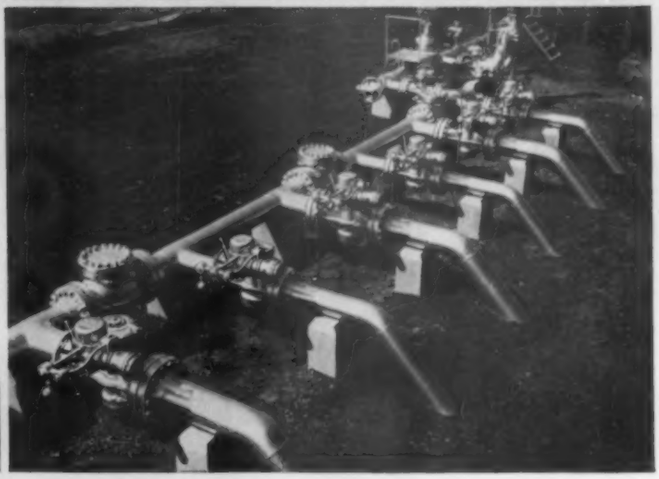

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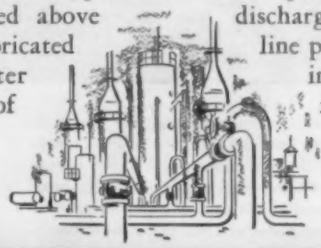

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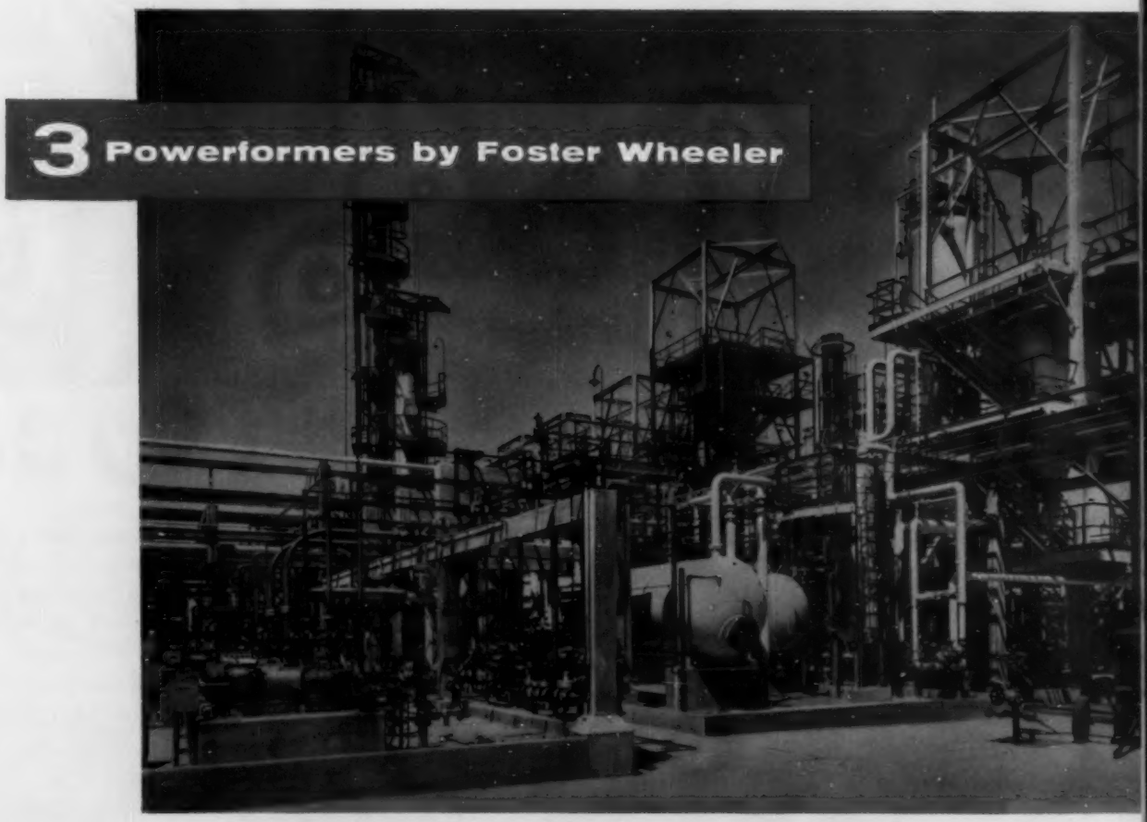

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This combination provides the refiner with a most effective means for the catalytic reforming of low-octane naphthas into high-octane motor fuel components.

Powerforming, developed by Esso Research and Engineering, has already proved its outstanding performance on three units which are now in successful operation. Fourteen more are under construction or in the design and planning stage.

The first Powerforming unit, shown at the left, in operation since May 1955 was designed and constructed by Foster Wheeler for Esso's Baltimore refinery. FW is currently providing mechanical design and construction for two more Powerforming units — a 20,000 barrel per day unit at the Bayway refinery and a 7,000 barrel per day unit at Imperial's Halifax refinery where Foster Wheeler is also building Crude Distillation, Fluid Catalytic Cracking, Polymerization and Treating units. For further information write to *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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Neal VanMiddlesworth

New Scouting Service For Venezuela

A new scouting service for Venezuela was launched in Caracas the first of this year. VOSA (Venezuelan Oil Scouting Agency) was organized by Neal VanMiddlesworth, formerly Mene Grande Oil Co., chief scout.

VOSA turns out weekly and monthly industry-wide reports on well status and completions, rigs operating, field parties active, production and related material. It also furnishes well cards and a news letter to clients, and will offer a map service in the near future.

VanMiddlesworth first went to Venezuela with Mene Grande in 1939. He resigned in 1942 to join the Army, returned in 1948, and was their scout up to the time of his resignation to strike out for himself. He has been a frequent contributor to this magazine.

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EDMONTON IS CANADIAN OIL
Yes, Edmonton is THE centre of the Canadian Oil Industry. Here is all the bustling activity of pipelines carrying the lifeblood of industry West to the Pacific Coast and East to Superior and Sarnia . . . of multi-million dollar refineries . . . of petro-chemical giants . . . and of a multitude of secondary industries. Small wonder Edmonton leads Canada in population gains, building permits and general expansion. It's a steady, healthy growth based on a sound economic outlook. Edmonton is the centre of the population trend Northward—the hub of the population density of Alberta. Get all the facts on this amazing city today!
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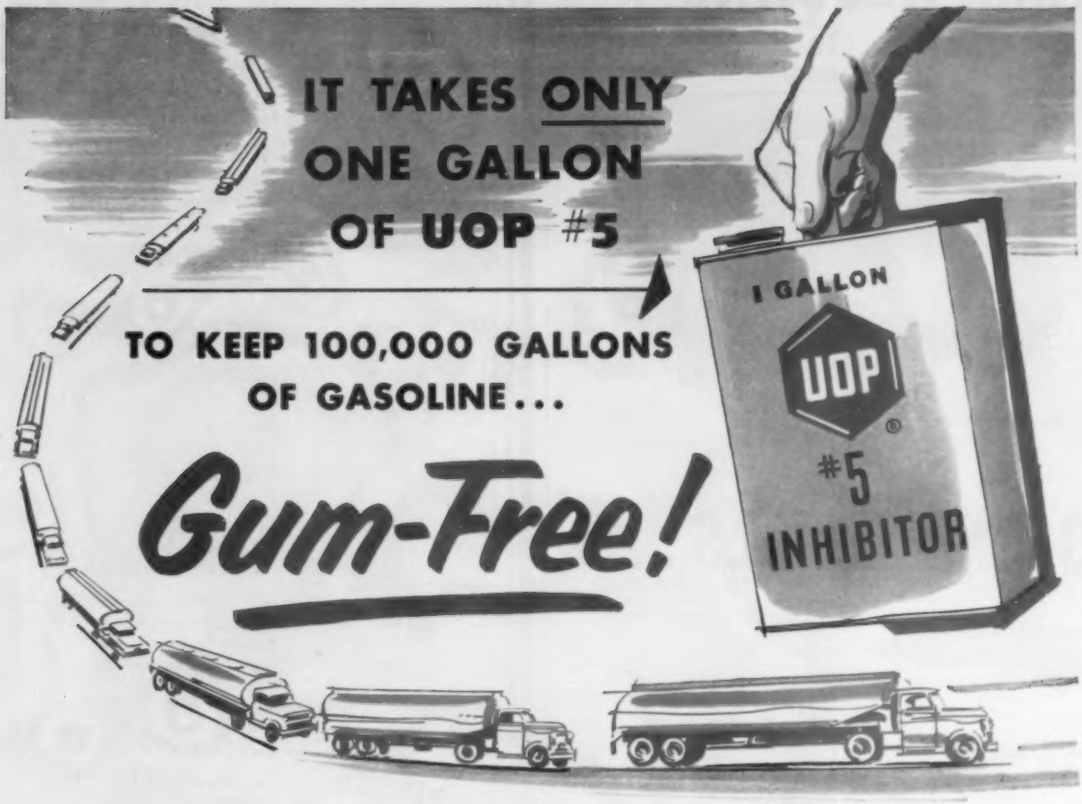

UOP #5 Inhibitor is the most economical you can use. And by experience and test it is also the best—the only inhibitor that can handle the really tough stability jobs.

Actually, only 5 molecules of UOP #5 will protect as many as 1,000,000 molecules of today's tailor-made gasoline from the formation of gum, the one universally recognized cause of engine manifold deposits. It's effective, too, in preventing the decomposition of TEL in stored gasoline. Is it any wonder that UOP #5 is the standard of comparison in the industry?

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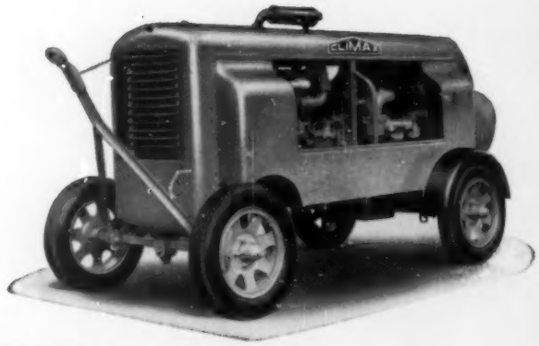
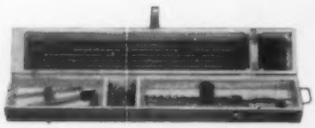


F 80A Portable Compressor

TOOLS AND DRILLS...

Do-all twist/hammer drill

Trench pump



Mackintosh prospecting tool

R.V. 258 drill

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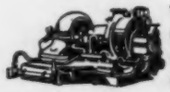

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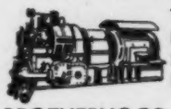

Turbine driven up to 11,000 KW.
Engine driven up to 340 KW.
Scores in hand, hundreds in service.

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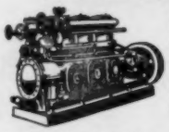

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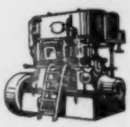

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Many in hand and hundreds in service.

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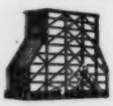

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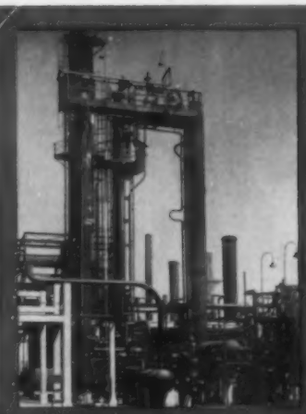
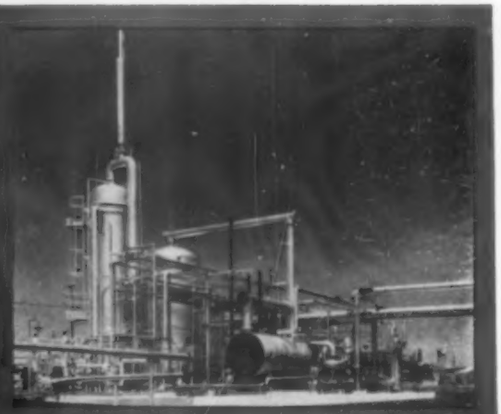
Girdler ammonia plants are now under construction in Ontario, Maine and Georgia.

Hydrogen Plants
Chemical Processing Plants
Hydrogen Sulfide Plants
Synthesis Gas Plants
Carbon Dioxide Plants
Gas Purification Plants
Plastics Materials Plants
Carbon Monoxide Plants
Nitric Acid Plants
Acetylene Plants
Sulphur Plants
Ammonia Plants
Formaldehyde Plants
Ammonium Nitrate Plants
Fertilizer Plants
Phosgene Plants

Catalysts & Activated Carbon



This Girdler GIPSOTOL plant purifies both liquid and gaseous hydrocarbons.



This Girdler plant recovers elemental sulphur from hydrogen sulphide.

• Take advantage of Girdler's proven experience when you start to plan your processing facilities.

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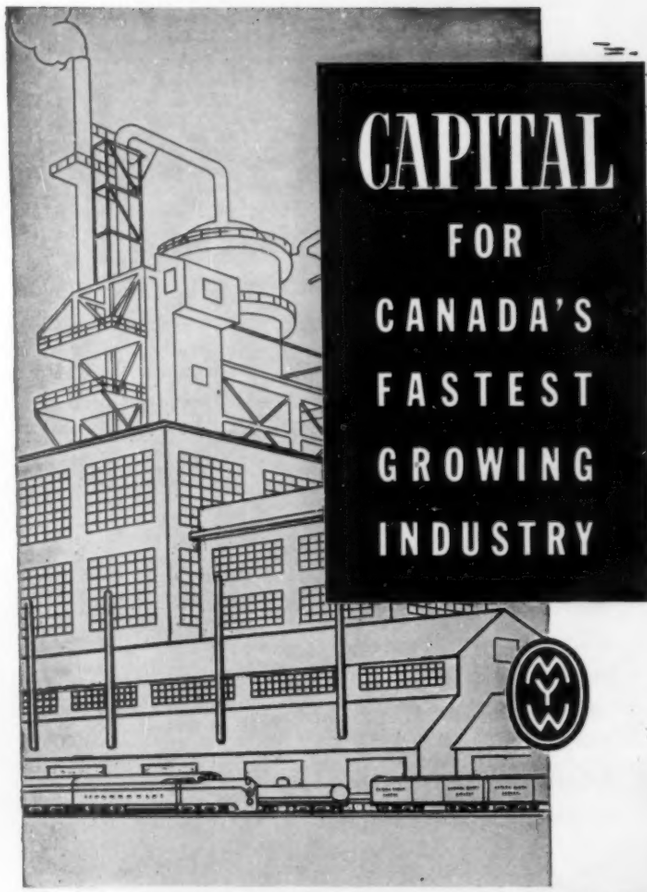

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The runner and other castings have been made by Birkett, Billington and Newton for this 750 H.P. Pelton Wheel Generator supplied to the New Zealand Government by Gilbert Gilkes and Gordon Ltd., of Kendal.

Castings from a few ounces to 10 tons in phosphor-bronze, gun-metal, aluminium-bronze, manganese-bronze and light alloys. Precision-machined bushes and bearings. Specialists in high-tensile aluminium-bronze castings, centrifugal-cast wheel blanks, and chill-cast rods and tubes.

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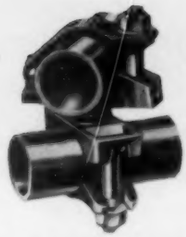

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MANUFACTURED TO B.S.S. 1139-1951
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STANDARD RANGE OF PUMPS WITH CAPACITIES
UP TO 30,000 BARRELS PER DAY

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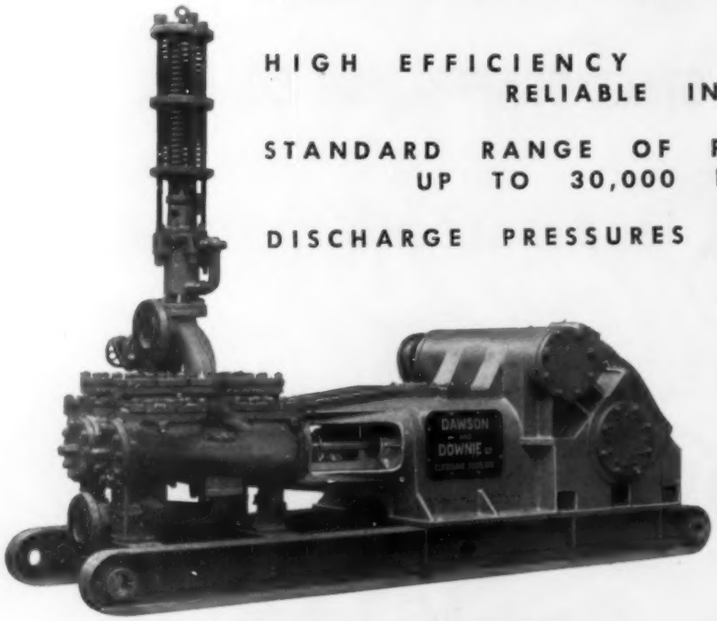

Illustration shows one of a series of pumps supplied to BRITISH PETROLEUM CO. LTD.'S refinery at ADEN, for pumping diesel and fuel oils from the refinery to the B.P. bunkering installation.

DAWSON & DOWNIE LTD

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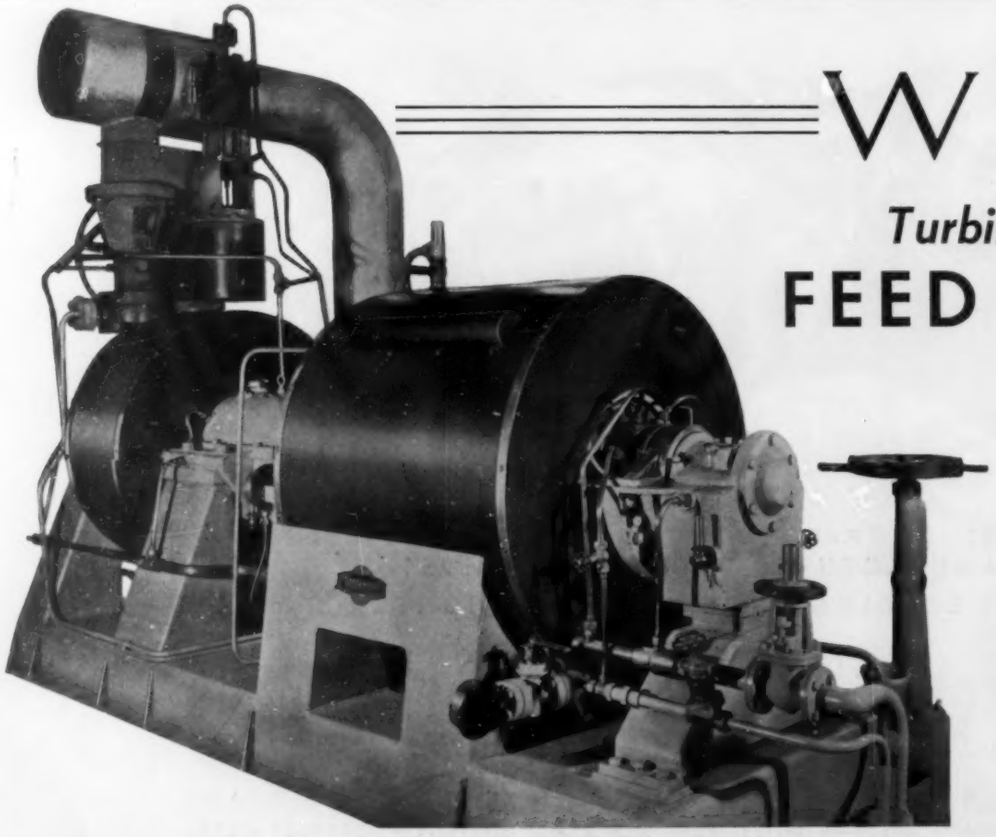

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WHY do operators now call for PGAC's Atlas Bullet Gun more and more every month?

because only the perforations in their formations PAY OFF.....

NOT Bullets at the bottom of wellbores!

The 8-year competitive record of bullet perforating shows that the recovery of bullets (with retrievable junk baskets) from wells perforated by the Atlas gun, has been consistently and practically **nonexistent.**

Did you know that Atlas Bullet Guns have fired over 1,500,000 bullets without ever breaking or losing any part of a gun in a well? . . . without even breaking . . . blowing a single cannon?

Tests prove that when a bullet gun employing the usual powder is exposed to 200°F. for only 30 minutes, much of its power is lost.

On the other hand, only PGAC uses a special temperature-stable powder—and this powder is used in all PGAC bullet perforators. By contrast, when PGAC's special powder is identically exposed to 200°F. for 30 minutes or longer, its penetrating power is **actually increased** approximately 10%.

PGAC's temperature-stabilized powder undoubtedly contributes much to the Atlas Bullet Gun's outstanding record for **consistent performance** in field operations.

The 8-year record of the Atlas Gun is equally striking . . . for remarkably few misfires experienced in normal operations . . . for successfully perforating wells after other bullet guns failed . . . for the safety of wells and personnel, year in and year out.

We published this ad first in 1955 Everything we said here then has Added Significance now!

The Atlas gun has consistently out-performed all other bullet guns, including the so-called super-guns, in field operations—and yet has never required a premium charge. Has PGAC been misguided in not calling the Atlas a "Super Gun," and in not charging a "premium" for its use? Evidently not, for the 8-year record of PGAC's phenomenal growth PROVES that operators now call for the Atlas Bullet Gun more and more every month!

MEMO: For more data, please write PGAC's Houston office and request your free copy of "Gun Perforating Techniques And Applications," a reprint from a recent issue of The Drilling Contractor Magazine.

PGAC 560-A

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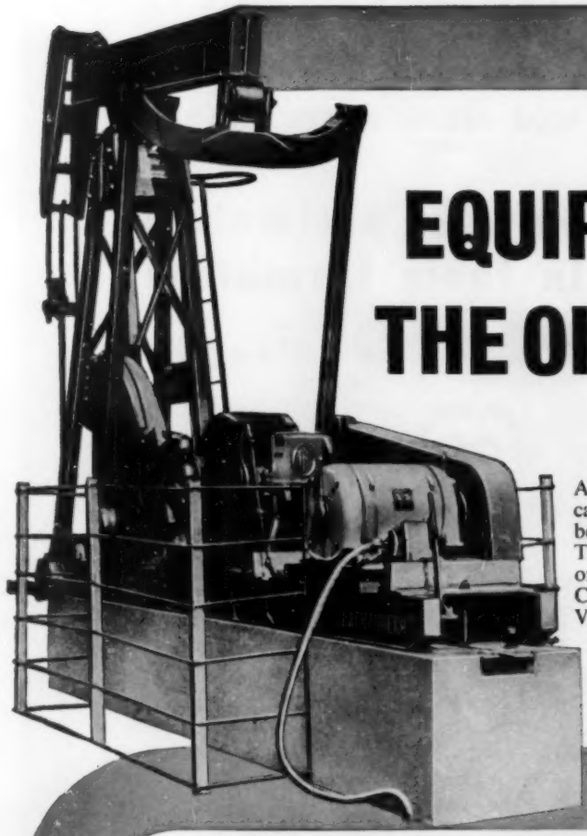
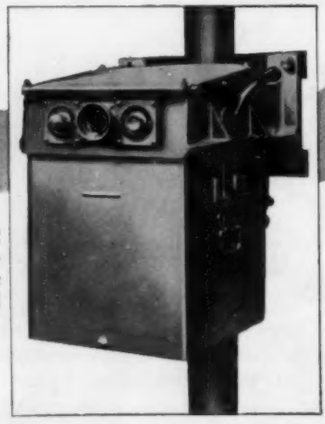
LOUISIANA: Houma — Lafayette — Lake Charles — Shreveport. KANSAS: Great Bend — Liberal. NEW MEXICO: Hobbs.

AFFILIATE COMPANIES: CANADA — Perforating Guns of Canada, Ltd.; Edmonton, Alberta
GERMANY — Atlas Deutsch- Amerikanische Olfelddienst G. m. b. H.; Kiel VENEZUELA — Servicios Tecnicos Atlas, C.A., Caracas

EQUIPMENT FOR THE OIL INDUSTRY

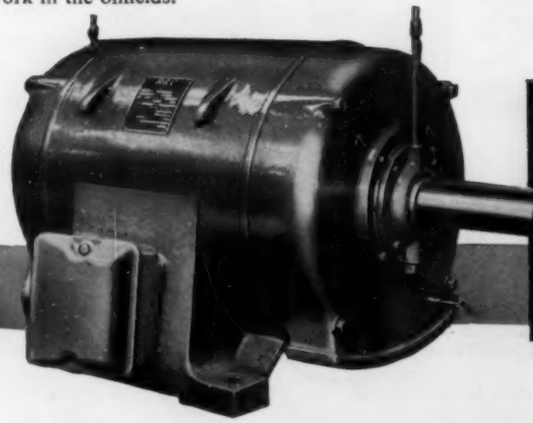


A high torque squirrel cage motor driving a beam type well pump. This installation is on one of the oilfields of Compania Shell de Venezuela.



A combined circuit breaker and contactor starter for the automatic control of oilwell motors.

A G.E.C. weatherproof motor designed and built for arduous work in the oilfields.



BY G.E.C.

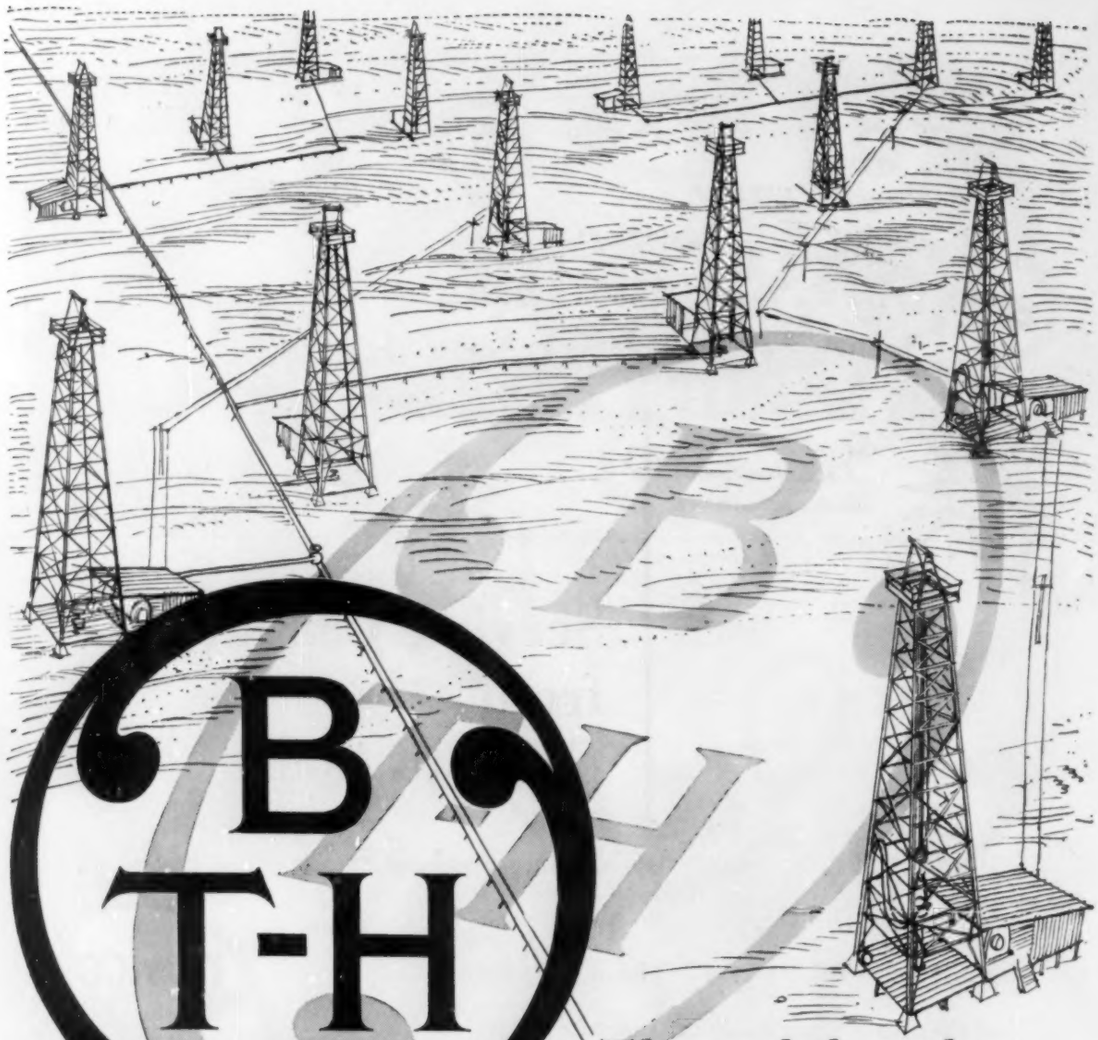
THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

Serving Canada from Coast to Coast

McCOLL-FRONTENAC extends a sincere and hearty welcome to all delegates to the twenty first Mid-Year Meeting of the Division of Refining of the American Petroleum Institute to be held in Montreal on May 14th—17th.

McColl-Frontenac Oil Company Limited

Manufacturers and Distributors in Canada of Texaco Petroleum Products



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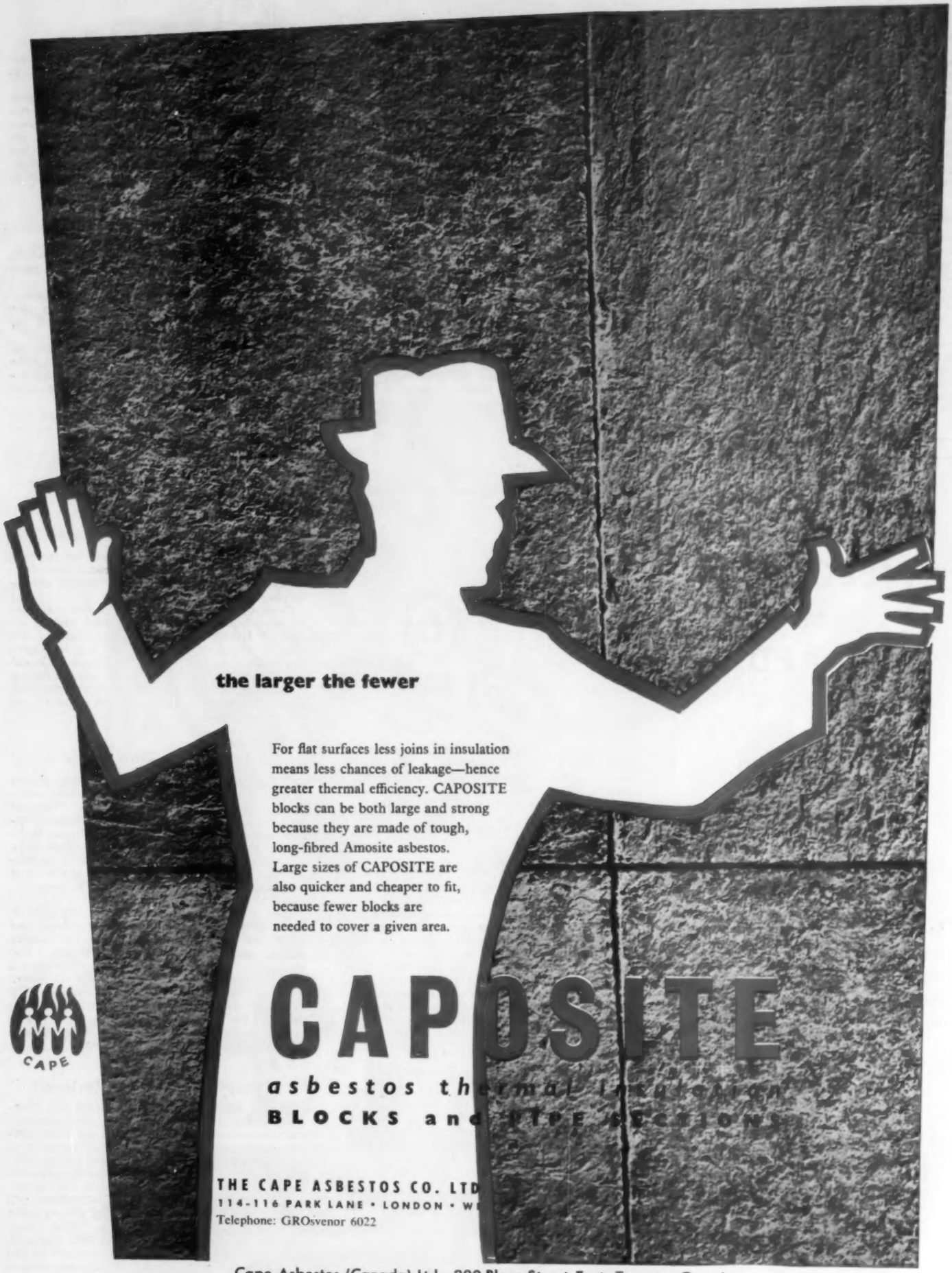
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Wildcat In Pakistan

Standard-Vacuum Oil Company is preparing to drill a site in the Indus River Valley 10 miles north of Jedda in the Province of Sind. It is expected that the rig will be ready to "spud-in" about June 1.

The site is in the 10,000 square mile West Pakistan concession granted in 1954 under terms of an agreement in which the Government of Pakistan shares in the risks of the search through a 25% participation in the exploration costs. Stanvac will supply the other 75%.

Ivory Coast And Senegal Exploration

A report covering progress in petroleum exploration on the Ivory Coast and Senegal has been published by the Director, Service des Mines, Dakar, French West Africa, it was learned. Several American oil companies have expressed interest.

"People's" Oil Shares in Austria

A proposal to issue what would be termed "People's Shares" to develop the country's oil industry is made by the Austrian People's Party as a compromise solution to the Socialist Party's proposal to nationalize the oil industry completely.

HOUSTON'S
WELCOME
to the
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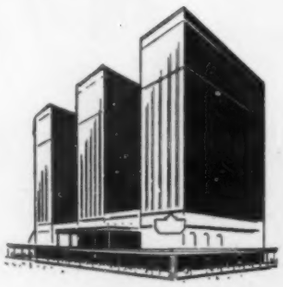

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RICE HOTEL
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DOWNTOWN HOUSTON,
TEXAS

Ohio Oil Explores Abroad

J. C. Donnell, president of Ohio Oil Co., recently called attention to his company's interest in foreign operations. He defined the interest in areas abroad as "The most significant change in The Ohio Oil Company's policies during the past few years." He noted that mounting costs of discovering and developing new reserves in the United States have been a factor in the growing emphasis on foreign exploration.

Speaking to members of the New York Society of Security Analysts, Mr. Donnell outlined recent development of Ohio Oil's foreign operations. The company now holds an interest in concessions covering more than 173 million acres in Africa and 4,390,000 acres in Canada, and has applications pending for concessions in Venezuela and Guatemala.

Ohio Oil's annual exploratory and development expenditures have doubled from about $24 million in 1950 to about $51 million in 1955. During this same time, expenditures in foreign areas have grown from 3% to over 15% of these totals, and will be higher in 1956.

Mr. Donnell reviewed Ohio Oil's progress in Canada where the company has had production since 1949; in Egypt where two exploratory wells are drilling; and in Somalia, British Somaliland, Libya, Guatemala and Venezuela where large areas are being studied through geological and geophysical exploration.

Attock Oil Report

Attock Oil Co. Ltd.'s annual report indicates production for the year 1955 was 1,387,285 barrels (3,801 b/d).

The deep test at Khaur field proved a failure both as regards deep and immediate producing zones and has been abandoned.

Output from Balkassar and Joya Mair fields has been satisfactorily maintained.

Refinery throughout amounted to 3,659 barrels per day on the Company's account and 1,148 barrels per day on account of Pakistan Petroleum Limited (The Burmah Oil Company Limited's subsidiary) during 1955.

The new gas pipe line connecting the Dhulian field with Rawalpindi was completed and the refinery has operated on gas fuel from December 23.

Petrofina in Germany

The Belgian oil company, Petrofina, is reported to be starting motor fuel production in May at the refinery of the former Ruhrbau company at Mulheim. In 1955 Petrofina acquired 75% of the shares of this German refining concern, whose plant has been shut down as it was unprofitable. The remaining 25% is owned by Farbenfabriken Bayer Co.

Cracking for Plastics in Germany

An oil cracking plant built by Farbwerke Hoechst for the Casella Chemical Works Co. with an annual throughput of 50,000 tons has started operations at Frankfurt to provide raw materials for plastics manufacture. The company has a license from Imperial Chemical Industries for the manufacture of Terylene and will market its polyester fibres under the name of Trevira. Some DM 233 million ($53.2 million) was spent on plant expansion and modernization in 1955 and investment this year is put at DM 200 million ($50.4 million). An electronic computer is under construction for plant control.

Oil Search in France

A new company, Soc. Internationale de Forages Petroliere (Interfor), has started operations in the Camargue region of southern France. This company has been formed by the French oil exploration company, Soc. Languedocienne de Forages Petroliers, and the Italian S.I.A.P., subsidiary of the state oil concern, A.G.I.P.

Oil Find In Pakistan

The Pakistan Petroleum Co. has reported a discovery about 18 miles from Chakwal Tehsil in Jhelum District at Karsal village at a depth of 12,000 feet. The Pakistan Petroleum Co. had started the well in May. The well is being tested.

To Direct Israeli Drilling

Rimrock Tidelands, Inc., has signed a management contract with Matsada United Drilling Co. Ltd., in Israel.

Rimrock will furnish a drilling superintendent, tool pusher and drillers for up to six complete rigs for Matsada, operating subsidiary of Lapidath-Israel Petroleum Company, Ltd., which brought in the Israeli discovery well in the Heletz region last September. Under the contract arrangement, Rimrock Tidelands will also train Israeli personnel in drilling operations for Matsada.

Indian Exports

India became an exporter of petroleum products during the last half of 1955, according to figures from Washington.

Exports during the last half totaled 78,800 tons of gasoline and 123.000 tons of furnace oil. They went to Pakistan, Burma, Ceylon, Australia and the Philippines.

Both Burmah-Shell and Standard-Vacuum refineries at Bombay were in full operation for the first time in the last half, and with the Digboi refinery at Assam their total refined output exceeded domestic consumption in these products.

There remain imports of aviation gasoline, solvent oils and lube and jute scratching to the full extent of needs, however.

Indian consumption of petroleum products now is at about 3.75 million tons a year (about 7,500 b/d). Production in 1955 was 3.45 million tons (about 6,900 b/d).

Cities Service Expenditures

Cities Service capital expenditures for 1956 will be $135,000,000, 80% of which is directed toward increases in the company's oil and natural gas reserves.

Company executives also project a five-year capital expenditure program, 1956 through 1960, in excess of $750,000,000. A large percentage of this amount would be expended on the continuing search for new reserves, but the program likewise embraces substantial new activities and additions to facilities in manufacturing, research, transportation, marketing and petrochemical phases of the oil and natural gas business.

Insight into Tanker Life

There was an unusual, possibly unique, feature in tanker launching ceremonies when Shell Petroleum's 31,000 dwt steam turbine vessel "Volvula" took the water on February 27 at the Wallsend-on-Tyne shipyard of Swan, Hunter, and Wigham Richardson, Ltd. Shell had invited a party of 78 senior boys, chosen from 39 of the leading schools in Britain, to see for themselves something of the many techniques and skills required in the building of a ship.

Prior to the launching, the morning was spent in a tour of the 130-acre shipyard and dry docks, and in Wallsend Slipway & Engineering Co.'s engine works. After the launching the party saw a film show, including one—"Proud Ships"—which should have given the boys some idea of daily life aboard a modern tanker and of the careers available. The "Volvula," the fourth of its class to be launched in the U.K. for Shell, is driven by a single screw-geared turbine developing 14,500 shaft horsepower, and its service speed will be 16½ knots.

Sunray Mid-Continent Reviewed

During 1955, Sunray Mid-Continent Oil Company drilled or participated in 361 net exploratory and development wells. Of the 361 net wells completed, 109 were net exploratory or wildcat wells in 13 states, resulting in 29 discoveries. During 1955, the company produced approximately 35 million net liquid equivalent barrels of oil and natural gas liqiuds. During 1956, Sunray Mid-Continent will drill or participate in the drilling of 459 net wells. Of these projected oil and gas wells, 138 are scheduled to be exploratory wells. At 1955 year-end, Sunray Mid-Continent owned undeveloped oil and gas leases covering a total of approximately 4 million acres.

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AGENCY OFFICES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

2/7/53/2

1955 Financial Review of Canadian Oil

(*Continued from page 114*)

McCOLL-FRONTENAC AND SUBSIDIARY COMPANIES

FINANCIAL	1955	1954
Gross income	$116,547,090	$101,824,222
Net income before income tax	17,351,094	14,133,283
Net income for the year	10,283,094	7,940,283
Depreciation, depletion & amortization	7,469,254	6,223,845
Working capital	26,942,791	24,624,752
Ratio current assets to current liabilities	2.84	3.02
Total assets	100,386,557	90,842,829
OPERATING (Barrels)		
Gross crude oil production*	3,182,557	2,687,437
Net crude oil production*	2,878,056	2,453,254
Crude oil purchases, less sales	15,879,380	12,319,328
Sales of petroleum products	17,073,584	14,450,528
Refinery runs to stills	18,581,803	14,948,734

* Canada & Trinidad combined

Canadian Petrofina Limited—Canadian Petrofina showed a net profit for 1955 of $1,026,289, compared with $163,083 in 1954, the company's first full year of operation.

The company's gross operating income in 1955 was $25,311,233, compared with $7,453,919 in 1954.

The figures consolidate those of Western Leaseholds Ltd. and Calvan Consolidated Oil & Gas Co., Ltd., in which Canadian Petrofina acquired 96% and 91% respectively of the stock outstanding. The two companies were integrated into the Petrofina organization. The report reflects operating results of Western Leaseholds for only six months of 1955; for Calvan, ten months.

Summarizing the results of its acquisition of Western Leaseholds and Calvan, Petrofina reports that it now holds with its subsidiaries interests in 407 oil wells and 48 gas wells. From them the aggregate net yield last year was 3,125,000 barrels of crude oil and average net rate of production was 10,300 b/d daily at the end of the year. Crude oil reserves controlled are estimated at 55 million barrels.

CANADIAN PETROFINA LIMITED

Comparative Figures

FINANCIAL	1955	1954
Gross revenue	$25,844,255	$7,864,757
Net earnings after taxes	1,026,289	163,083
Working capital	13,618,473	8,596,829
Total assets	140,803,647	37,359,024
OPERATING		
Net crude production (b/d)	10,300	175
No. of oil wells	407	26
No. of gas wells	49	..
Crude oil run to stills (barrels)	1,438,711*	..

* Last quarter of 1955 only.

Royalite Oil Company, Limited—Royalite showed an increase in net profits of 31.7% during 1955, to a level of $1,043,437 during the year. Working capital of the company increased by 53.4% to $9,057,623 during the year. Operating revenues showed a rise of 51.6% to $22,370,143.

Comparative figures for the company's operations during 1955 are as follows:

Operating revenue	$22,370,143	$14,754,657
Net operating income	2,332,339	1,849,231
Net earnings	1,043,437	792,164
Dividends paid preferred (per share)	1,3125	.219
Common (per share)	.26	.26
Working capital	9,057,623	3,375,933
Capital expenditures	4,440,236	6,512,657
OPERATIONAL		
Net crude oil production (bbls)	2,183,216	1,845,256
Natural gasoline production (bbls)	419,947	392,952
Propane production (gals)	5,345,590	5,612,483
Sulfur production (tons)	11,251	10,334
Natural gas sales (mcf)	22,965,017	21,148,075

Husky Oil & Refining Limited—Husky Oil and Refining reached an all time high of $13,668,452 in sales during 1955. Net operating income was $2,618,535 before depreciation and depletion. Net earnings were $24,418 down from 1954 due to expenditures attendant upon the company's expansion of refineries and marketing facilities which reached a new high of $6,330,031.

Highlights of Husky's operations in 1955, compared with 1954 are:

FINANCIAL	1955	1954
Net refining & marketing sales	$12,375,447	$8,424,312
Total revenue	13,668,452	9,725,017
Net profit	24,418	501,972
Net profit per common share	.012	.255
OPERATIONAL		
Crude oil produced (barrels)	904,278	575,350
Crude oil processed (barrels)	3,689,958	2,651,812
Natural gas produced (mcf)	1,070,252	1,124,137

Capital for Oil Companies

The facilities of our organization are available to executives of Canadian and American companies engaged in all phases of the oil and gas industry —exploration, development, pipeline and refining.

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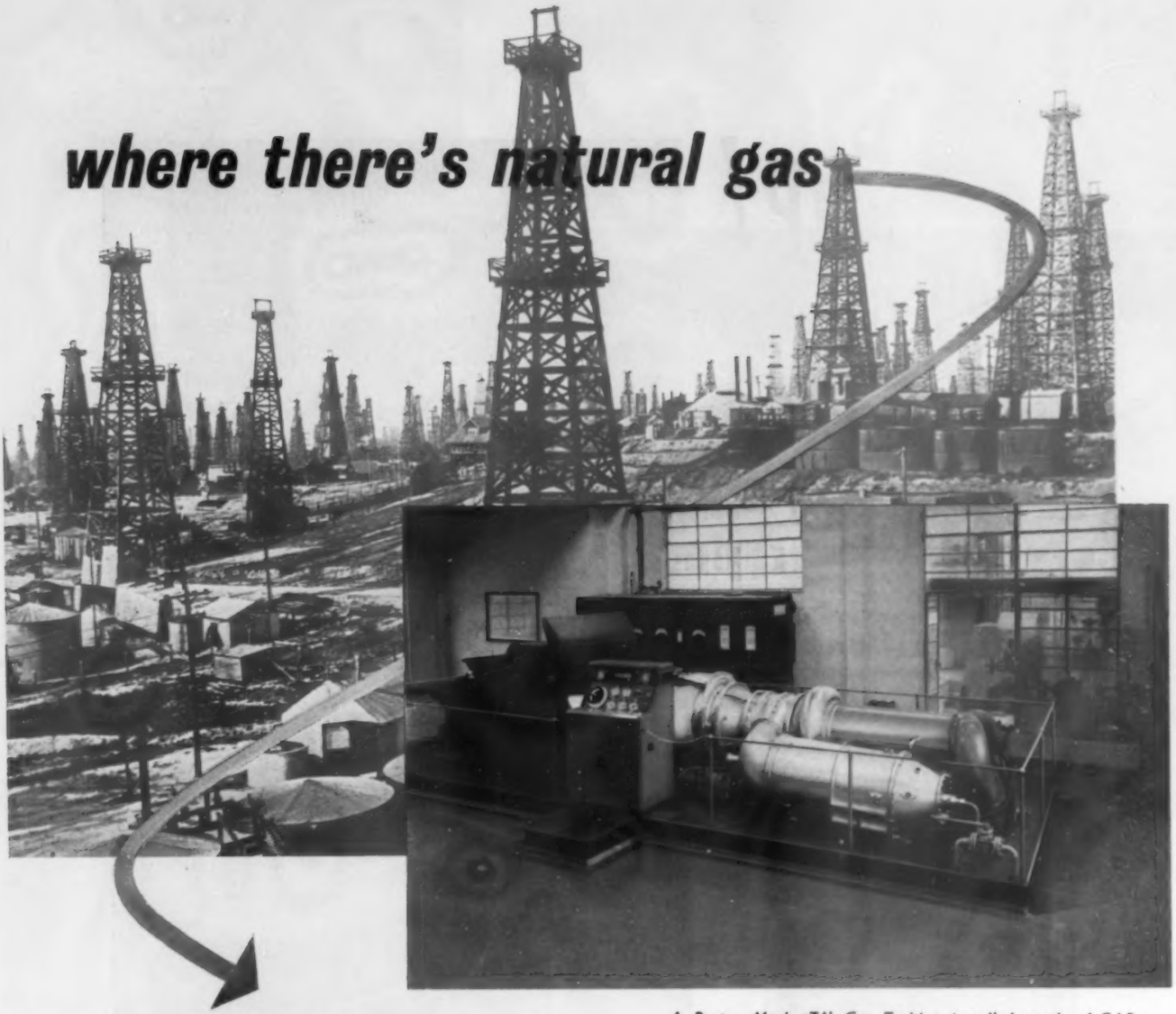

A Ruston Mark 'TA' Gas Turbine installed at the A.G.I.P. refinery at Cortemaggiore, Italy, runs on natural gas and supplies power and heat for the plant.

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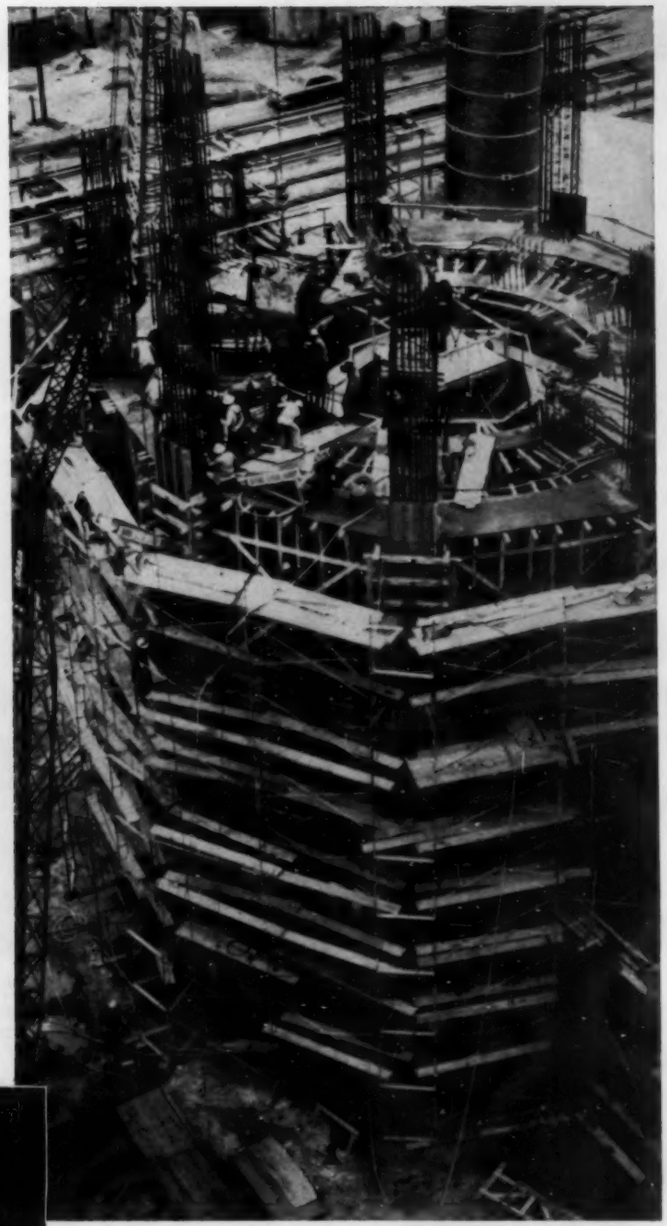

Part of New York's skyline—TCC Unit at Socony Mobil's Brooklyn refinery.

West Germany—TCC Unit at Heide Refinery of Deutsche Erdol-A.G.

TCCs are operating on all six continents—from Finland to Formosa, from Australia to Turkey

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COMPRESSED PILE COMPANY OF CANADA LIMITED

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In 1950, 350 Franki caisson piles were used in the foundations of the British-American Oil Company Ltd at Moose Jaw, Saskatchewan.

Other oil refineries built on Franki caisson piles throughout the world as hereunder listed:

Argentina	— Yacimientos Petroliferos Fiscales Refinery
Belgium	— S.A. Belge Raffinage des Pétroles Albatros; S. A. Raffinerie Belge des Pétroles; Esso–Shell–Standard Amer. Petroleum Company
Brazil	— Standard Oil of Brazil; Petrobras; Distillery Correia e Castro
Canada	— B.A. Oil Company Ltd; Mc-Call Frontenac Refinery
France	— Shell Berre Refining Company; Vacuum Oil Company; Esso Standard; Atlantic Oil Refinery; Jupiter Oil; Société des Pétroles du Nord; Purfina Refinery
Great Britain	— Vacuum Oil Company
Iraq	— Refinery for the Iraq Government
Italy	— Socony-Vacuum Italiana; Refinery Azienda Generale Petroli; Refinery Condor
Portugal	— Socony-Vacuum Portuguesa; Refinery Sacor
South Africa	— Standard-Vacuum Oil Company

International News and Notes

(*Continued from page 180*)

Forest Oil In Cyprus

Forest Oil Co., Bradford, Penna., is stepping up the hunt for crude oil in Cyprus, despite the unrest there. Forest D. Dorn, chairman of the board, recently said the company plans to apply for a license to conduct preliminary surveys and prospect for oil. If the outlook is favorable, they would seek concessions. Indications are the government is agreeable.

Forest is interested in the entire island, except the mountain ranges and a small area near Larnaca, where a local operator has been drilling for oil unsuccessfully.

Company officials asked U. S. officials if they would need special protection. U. S. officials replied that any oil operations might face physical risks, but that the work should be able to continue.

Exploration in Syria

The government of Syria is sending out "hurry up" notices to James W. Menhall. Mr. Menhall, an independent American oil man, has a permit from the government to explore for petroleum in 28 tracts of 300 square kilometers each scattered throughout Syria. Most are in the north and northeast. Terms of his permit require him to start drilling by May 26. American geologists have scouted the area, and one or more drillings rigs are reported en route.

Oil companies and individuals have filed applications for permits, although Mr. Menhall is the only one granted a permit during 1955.

B. Orchard Lisle, editor of *Oil Forum*, has applied for a permit, according to U. S. officials in Syria. Two Syrian businessmen have applied. They are Zayiri Tayyara of Homs, and Rudolph Saedeh of Latakia.

The government says it will give preference to firms with technical and financial ability, and not necessarily to the first to apply.

USSR Gas Industry Speeds Up

The Soviet Government is trying to increase use of natural gas. The principal reason is cost, since the unit cost of extracting and supplying gas to Moscow is 3.2 times cheaper than that of mining an equivalent amount of coal around Moscow, and secondly, because less manpower is needed.

Millions of cubic feet are being flared at the oil wells of Tartary, Bashkiria, the Kuybyshev, Stalingrad, and Krasnodar regions and at certain oil refineries. In 1954, by-product oil gas equal to approximately 2.5 million m/tons of equivalent fuel was burned at the oil wells of the main oil regions of the USSR alone.

Local Party and Soviet organs apply to the Government with a request for gas. After a gas line is laid to the area, installation of gas in the towns may be delayed; meanwhile, the main lines remain idle. The gas facilities in such towns as Ordzhonikidze, Stavropol, Krasnodar, Stalingrad and Ufa, are being used to less than half their capacity.

One of the main bottlenecks is the low production of pipe. Only in March 1955, did the Ministry of Ferrous Metallurgy of the USSR begin to turn out special pipes with 27.58 inches diameter. Some pipe is made with a wall thickness over the planned index of 0.078–0.177 inches, which wastes metal.

Another difficulty is gas engine compressors, produced by the Ministry of Heavy Machine Building, which are said to be inadequate of long-distance gas supply, and even these compressors are being produced in a limited number. The Ministry of Heavy Machine Building has been adapting compressors, using as models foreign high-pressure turbo-compressors of an output of 529.65 million cu. ft. per 24 hours, driven by a gas turbine or piston engines of a capacity of 5/6,000 h. p.

Still another bottleneck is the lack of cross-country vehicles, machines and machinery for welding, cleaning, insulation and earth work.

During the post-war period, some of the main gas pipe lines which have been laid are as follows: Saratov-Moscow, Dashava-Kiev-Moscow, Tula-Moscow and Kokhtla-Yarve-Leningrad. Gas mains have been laid in Kuybyshev, Kazan, Ufa, Stalingrad and some other towns. The installation of gas in apartment houses has been basically completed in such towns as Moscow, Leningrad, Kiev and Lvov. Some plants for obtaining gas from coal and shale have been built.

As a result, the Council of Ministers of the USSR adopted in 1955 a gas industry plan for 1956–1960. Gas is to be installed in 132 towns, according to A. Alexandrow, and more than 250 major industrial enterprises and power stations are to switch to gas. Important centers such as Leningrad, Kharkov, Minsk, Rostov-on-Don, Riga, Vilnius, Voronezh, Kursk, Orel, Taganrog, Zhdanov, health resorts in Northern Caucasus and some other places are to receive natural gas. Gas will go for the first time to: Kursk, Kolomna, Morshansk, Novorossiysk, Krasnodon, Tula, Novocherkassk, Krasnodar, Rostov, Shakhty, Gorky, Sverdlovsk, Chelyabinsk, Zhitomir, Minsk, Vilnius and some other towns. 4,843 miles of gas line is to be laid in the towns so that almost 1.3 million apartments will have gas installed during 1956–1960.

The following gas pipe lines are to be laid during 1956–1960 (total length about 5,589 miles): Stavropol-Moscow, Dashava-Minsk-Leningrad, Stavropol-Nevinnomyssk-Mineralnye Vody-Grozny, Shebelinka-Kharkov-Kursk-Orel-Bryansk-Kazan-Gorky.

Work is to commence on pipe lines running Berezovo-Sverdlovsk, Kyzyl-Kum-Krasnovodsk, Grozny-Tbilisi.

In recent years large gas deposits have been discovered in the Ukraine, the North Caucasus and in the Volga region. Large-scale exploration for natural gas is planned in the Ukraine, the Urals, Siberia and the Stavropol and Volga regions. A total of 1,552.5 miles of hole is to be drilled for gas during 1956–1960. According to the Sixth Five-Year Plan, gas production is to amount to 1,412.4 billion cu. ft. in 1960, or 4.8 times over 1955. Gas production in 1955 was 25% higher than in 1954, corresponding to 294.5 billion cubic feet; therefore 1954 production must have been approximately 235.5 billion cu. ft., according to Communist plan figures. The gas production of the Azerbaidjan SSR was fixed by plan at 123.6 billion cu. ft. in 1960.

The generation of gas from coal and shale is to double within the next five years, so that by 1960 its share will be 9% in the gas industry.

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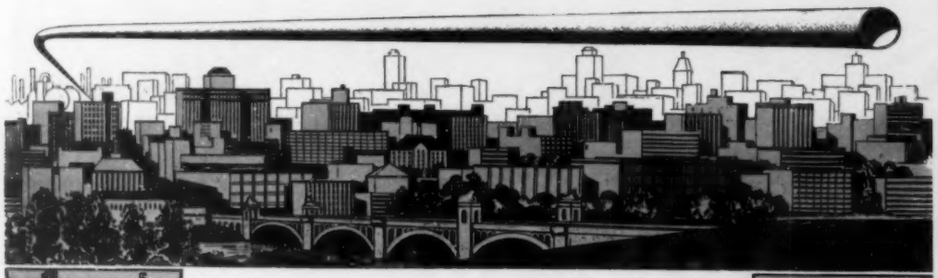

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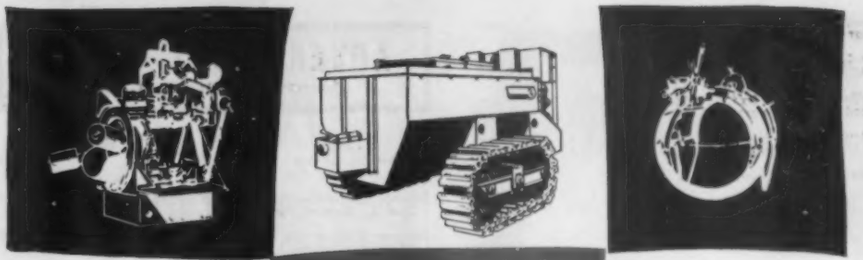

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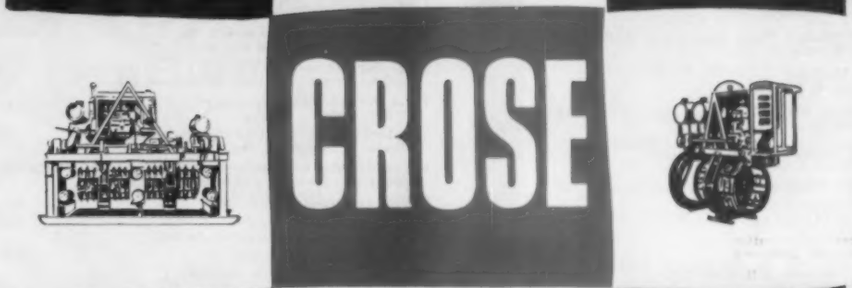

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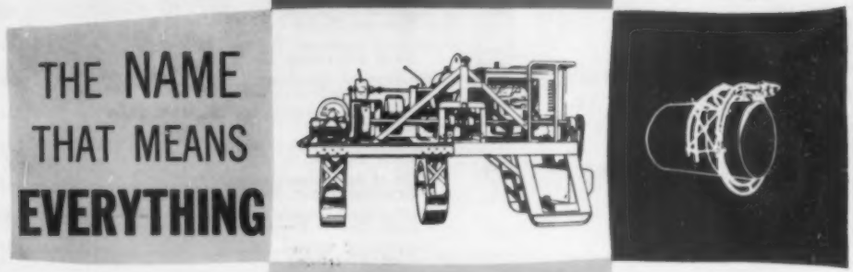

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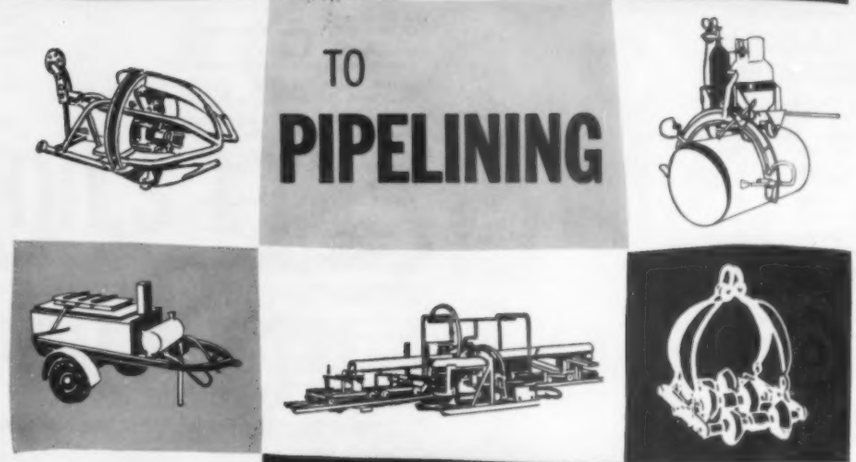

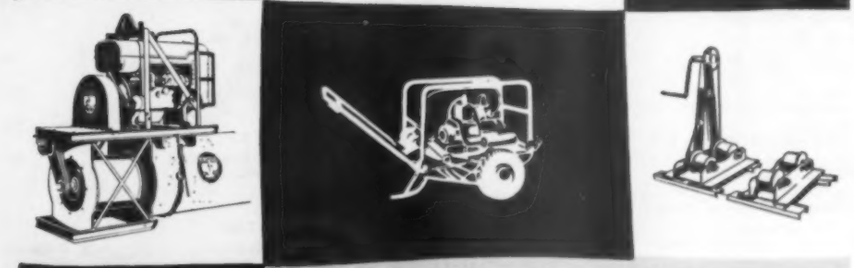

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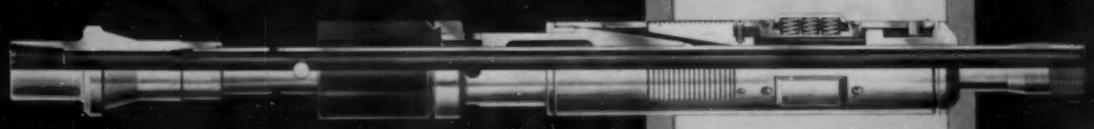
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